SEAS AND SKIES

IN MANY LATITUDES

R. Abercromby.

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Frontispiece.

THE ROPES OF MAUI.

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OR

Wanderings in Search of Weather

BY THE

HON. RALPH ABERCROMBY

[illegible]

MAPS AND ILLUSTRATIONS

LONDON: EDWARD STANFORD

26 & 27 COCKSPUR STREET, CHARING CROSS, S.W.

1888

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Wanderings in Search of Weather

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HON. RALPH ABERCROMBY

FELLOW OF THE ROYAL METEOROLOGICAL SOCIETY, LONDON; AUTHOR OF "PRINCIPLES OF FORECASTING BY MEANS OF WEATHER CHARTS," 'WEATHER," ETC.

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PREFACE

NOBODY would be justified in publishing a book of travels in the present day, when all the world is journeying, unless he had something to tell either in the way of adventure or of special research.

Of adventure there is nothing in this book; there is no more adventure now in an ordinary voyage round the world than in travelling from London to Edinburgh.

The special object of the voyages was to investigate the phenomena of the sky and weather in various parts of the world.

Numberless books of exploration and adventure have been published, and numerous naturalists' voyages have met with an appreciative reception from the hands of the public. Geologists and astronomers have succeeded in interesting the general reader in their journeyings; but no meteorologist has yet attempted the task.

The different races of man and beast, the varying forms of plant life, the mountains and rocks, the shells and fossils in all parts of the world, have

all fascinated the imagination of many readers; but strange to say, one of the most striking aspects of nature—the face of the sky—has never been methodically described by any traveller.

Volumes have been written on the climates of the world, and innumerable descriptions have been published of thunderstorms and hurricanes; but the cloudland, which gives life to every land or seascape, has hitherto attracted but little notice.

The Author has attempted in this book to describe the clouds and weather in the numerous countries he has visited, and to reproduce some of the photographs which he took from time to time in many latitudes.

While describing beaten tracks, he has only given enough narrative to bind the subject together; but when giving an account of less well-known countries, such as Fiji or Borneo, he has added more complete descriptions.

He has specially endeavoured to take a cosmopolital view of a subject when comparing the rival merits of places or things. For instance, a squatter coming down from the dry hills and monotonous gum-tree scrub of Australia may perhaps think the magnificent harbour of Sydney one of the most beautiful in the world, but any one who has also seen the harbour of Rio Janeiro will admit that the former cannot compare in grandeur to the latter.

One of the Author's strongest wishes was to encounter a tropical hurricane, either on sea or land, as there are several doubtful points connected with these storms which he hoped to settle by personal observation. But, though he selected the hurricane season for visiting Mauritius, and sailed all through the China seas in hope of meeting with a typhoon, he was not successful in his search. Still he collected a vast amount of novel information in different hurricane countries, which he hopes will be of use to scientists and seamen.

As this is a popular work, all technical details have been omitted from the body of the book, but a few points of special interest to meteorologists have been printed in appendices.

The Author begs to acknowledge his obligation to the Councils of the Royal Society and of the Physical Society; and also to the publishers of the *Illustrated London News*, and *Nature*, for the loan of blocks which have already appeared in their various publications. He is also much indebted to Mr. R. Pritchett for giving an artistic rendering to some of his own rough sketches of very difficult subjects, and for the beautiful sketch of edible birds' nests.

LONDON, *October* 1888

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CHAPTER I

IN CANADA: THE MUSIC OF NIAGARA

IN November 1864 I was ordered, on promotion, to join the 4th Battalion of the 60th Rifles, then quartered in Canada. Accordingly on the 17th of that month I embarked at Liverpool on board the *Damascus*, a small Mediterranean boat of only about 870 tons register, perfectly safe, but totally unfit to make the winter trip across the Atlantic with any comfort to her passengers.

The weather which we experienced was typical of the Atlantic at that season; westerly gales of varying strength, following each other in quick succession, and the temperature rising or falling slightly, according to whether the wind came a little more from the south, or a little more from the north of west. One night the curious appearance called "St. Elmo's fires" or "Corposants" was observed, as little balls of electric glow dancing at the end of the yard-arms. These lights are considered a sign, or rather an accompaniment of hard weather, and on this occasion appeared in the intervals of cold hail showers during a north-west gale.

The sea was always high, and when it rolled in long mountainous masses, the appearance of the ocean as seen from the tops of the waves resembled that of an undulating country. On one of these occasions we had simply to lie to, off our course, and keep the ship's head to the sea; but no harm was done, beyond the loss of a small portion of the bulwarks, and the smashing of the housing of a boat.

By the thirteenth day the *Damascus* arrived at the Banks of Newfoundland, and passed into the cold water and dense fog of the Arctic current. There was no floating ice now, as the bergs were held fast by the frost in Greenland; but still the water was so cold that the air was thick with fog. The layer of fog is sometimes so thin that while on deck you can scarcely see the ship's length ahead; at the mast head you find a hazy sun shining over a sea of mist. The weather was also quite different from what had been previously experienced, for we were now outside the course of the westerly gales, and beginning to feel the influence of the American continent.

A little later on, the ice-blink was seen over Cape Race, more than fifty miles distant, though the land itself was of course invisible. The whiteness of light reflected from snow or ice gives a peculiar colour and illumination to the clouds that lie over the frozen surface, quite different to the ordinary light reflected from sea or land; so that by day the sailor gets as good an evidence of his approach to land as would be afforded by a mountain whose top was as high as the clouds.

From the edge of the Banks to Portland in the State of Maine nothing but calm weather was experienced, though the ship did not arrive at Portland till the nineteenth day after leaving Liverpool. This was a very long passage even for those days.

We were introduced on landing to a very characteristic institution of the United States. The custom-house was swarming with young and inexperienced men, for whom there was little or nothing to do. This was explained by the fact that President Lincoln had just been returned for a second term of office, and an unusually large number of fresh appointments had been made. It was said that in a few months they would all be weeded out till the necessary numbers only were left.

Montreal was reached shortly before Christmas; it was then cold, and the navigation of the St. Lawrence had been closed for nearly a month, but no snow lay on the ground. Just before New Year snow began to fall in earnest, and no ground was seen again till the middle of March. There was not a single thaw, such as does so much harm in St. Petersburg, during the whole winter. Sometimes the thermometer rose to nearly 20° F., but never to the freezing point; while during January and February the temperature was usually from about zero to 10° F.

The character of the snow was remarkable and quite unlike what one sees in England. The flakes were usually small, six-sided plates, the sides a little rounded so as to look like the flattened petal of a

flower. They were so dry that they would not bind, —you could not make a snowball in all Canada—and drove in under the chinks of the windows like sand. The French *habitants* call this *poudré*, a word which exactly describes the character of Canadian snow. One day the snow fell in long thin hexagonal needles of dry ice, which were so uncommon that everybody remarked them. There was no very peculiar weather at the time, so that it is difficult to assign any reason for this formation. In England the commonest flake is made of a tree of similar needles, tacked together into a symmetrical form, and flat plates of ice are not at all commonly observed.

On the whole, weather did not change much from day to day during the winter. The sky was generally blue overhead, but the sun never had an overpowering glare in the town owing to a large amount of haze in the air. The horizon was always gray and obscure, though one very rarely saw much true cloud.

The total snowfall was not very large, but it is somewhat difficult to estimate the amount, for the wind drives a great deal from the open plains into the woods and hollows. At the end of the winter the depth of snow on the flat ground did not exceed three or four feet, though of course many of the railway cuttings were filled level with the ground. All traffic has of course to be carried on in sleighs, and for some reason the passage of the runners works a road into undulations like a series of solidified waves. The motion of driving over these is very unpleasant, and I have known people to be sick from the uneasy ship-

like motion of these *cahots.* On the other hand, nothing is more exhilarating than driving in a good sleigh over a smooth road, with the tinkling bells of the horses properly harmonised, and in company with a pretty Canadian girl, through the clear, dry, cold air of an American winter.

The rivers do not freeze over with a smooth surface like a pond; the tide and current effectually prevent this, but the mass of floating ice gradually gets jammed and then frozen together. The pressure tilts many of the flat pieces of ice up more or less on end, and the whole surface is rough like the ground over a highly-contorted slaty rock with thin *laminæ.* A few air-holes always remain open, and some parts are much stronger than others. The whole is called an "ice bridge." There was one opposite Montreal more than two miles long, where the rough surface had been smoothed, and bushes stuck in the ice on either side of the path to guide travellers by night or after snow. These bridges are very dangerous for troops; the blow of several hundred men marching in step is very severe, and about fifty years ago a great many men in one regiment were drowned near Toronto.

Winter is the gay season in Canada: everybody is in town then, business is slack owing to the stoppage of navigation, and sleighing parties, dances, theatricals, and picnics are the order of the day. There was a large garrison in Montreal during the winter of 1864-65, for the British force in North America had just been very much strengthened owing to a difficulty

with the United States about the affair of the Trent. What with five battalions of infantry and the usual proportion of staff, artillery, and engineers, we had a very gay and pleasant time of it.

Our own work was very light in that season; it was perfectly certain that no raid could be made on Canadian territory during the winter months, and the weather was sometimes so severe that we had to inspect the men in their barrack-rooms. In fine weather the troops went out marching on snow shoes, and with a little practice could skirmish across country far quicker than in ordinary boots. The only difficulty was that in close order the shuffling of the shoes over the snow made so much noise it was a little troublesome to get one's orders heard. Marching in very cold weather was actually dangerous. On the coldest day of the whole winter, when a brisk north-westerly gale blew from over the frozen continent, when the mercury fell to thirty degrees below zero, and my own battalion was very prudently paraded in its own rooms, the commander of another regiment actually took his men out to practise on snow shoes. No less than 147 were frost-bitten out of a total of 221, and it was said that several of the bandsmen lost their fingers. Nearly all the mischief was done in a few minutes, when the men had got out of the town and took off their sealskin mits to tie on the snow shoes. The commanding officer should have known better, as he had been in the country before. A court of inquiry sat on the occurrence, but of course its report was not published. Anyhow, the affair was

hushed up, though curiously enough two or three years afterwards I read a somewhat garbled account of the business in an obscure paper from the south of Ireland.

These cold snaps of weather that come with a north-westerly wind are locally known as "blizzards." Up country they are more dangerous than in Montreal or Quebec, and even the hardy *voyageur* sometimes falls a victim to the severity of the weather. The danger comes from the piercing wind which chills the body, and the driving blinding snow which hides the path of the traveller. If wood cannot be found, nature can only resist the cold for a certain number of hours; and the man must be frozen to death if no shelter can be reached. A very curious circumstance attends these deaths, for in many cases the victim is found nearly naked. When the body is almost reduced to an icicle, after desperate efforts to keep warm, only a very little blood continues to circulate languidly through the head. The nutrition of the brain is then so impaired that the mind wanders in delirium, and the singular delusion of a sensation of oppressive heat supervenes. Under the influence of this fancy the victim begins to strip off his clothes, and so hastens the fatal end.

A frostbite is easily recognised by the part turning white and becoming hard. The person bitten is usually entirely ignorant of the fact, as there is a total absence of pain; so it is an invariable custom if you see anybody frost-bitten to tell him so, or help him to rub the affected part with snow. If the bite

is taken in time there is not much harm done, though the part smarts when it is coming to, remains red and swollen for a short time, and is always more liable to be bitten again than another part of the body. In extreme cases, when the flesh is thawed, it swells enormously, rises in huge horrible-looking blisters, and gives intense pain. If the bitten part turns black in a day or two all is over with it, for the flesh is rotting, and nothing remains but amputation. Fever often supervenes at this stage; and during the Napoleonic wars at the commencement of this century the French lost thousands of men in Germany from *fiévre de congèlation.*

It is popularly believed that rubbing with snow is the only remedy, but this is quite a fallacy. A piece of fur is equally efficacious, and does not rub the skin off, as snow or ice are apt to do. The virtue of snow lies in the cold water produced when it melts, as this moderates the violence of the reaction in the flesh, and so far diminishes the danger of mortification.

A curious effect of dry cold is the constant crackling of clothes from the discharge of electricity. As you put your things off or on, anything of silk or flannel crackles, and if the candles are out you see a faint electric glow of light. When you do your hair a whole series of little cracks announce the disruptive discharge of electricity from the teeth of the comb. A common amusement after dinner is to set one of the party on four tumblers, rub him down two or three times with a bit of fur, and then see him light

the gas by putting his finger to the orifice of the burner.

Sometimes, even by shuffling hard across a room, sufficient electricity may be developed to light gas without the insulation of glass tumblers. The original source of the electricity is of course friction in every case, and for the same amount of motion, as much electricity is generated in England as in Canada. The difference in result is due to a thin varnish of condensed vapour which coats everything in England, and conducts the electricity instantly down to the earth. There is no such varnish in the extreme dryness of a Canadian winter, so the electricity rushes to any point from which to discharge itself. Otherwise, there is little atmospheric electricity in Montreal; thunderstorms are unknown in winter, and I only saw one *aurora borealis* in Canada.

The climate of Montreal has developed a distinctive architecture in the houses. The roofs are steep pitched, and covered with tinned iron, and the overhanging eave so arranged that snow is shot of its own weight clear of the side-walks, and as near as possible into the gutter between the side-walk and carriage-way. Inside the houses you are mostly struck by the absence of fireplaces, and by the universal use of double windows. In the best houses a flat colorifier, filled with hot water, that circulates round the house from a boiler in the basement, replaces an open fire. In barracks and commoner houses the long iron flue from a stove is led as far as possible through the building before it goes into the chimney. Wood is more generally used than coal,

and a newcomer is struck with the quantity of steam which is given off by burning wood. Dripping pans have often to be placed under joints in the flues to collect the dirty water which condenses in the pipes.

In the middle of March I took six weeks' leave, and ran through from Montreal to New York, some 700 miles nearly due south, in about thirty hours. The rapid change from a tropical to an arctic climate, as you ascend a mountain, has often been described. Here the passage was, in a few hours, from an arctic to an Italian climate by change of latitude. We left Montreal all white, the snow in the cuttings being higher than the railway carriages. We traversed Vermont and Connecticut in various stages of slush and thaw. We arrived in New York to find spring budding forth in a genial climate and a bright sun.

During this trip to the United States I had the good fortune to be present as a spectator at the battles round Petersburg, in Virginia, which led to the capitulation of that city, and the final surrender of the Confederate army under General Lee. Furnished with passes and good introductions to General Hunt, the Chief of Artillery of the Army of the Potomac, we went by steamer from Washington to a landing on the Appomattox river, a few miles in rear of the headquarters of the army. We found the Confederate army entrenched round the southern and eastern sides of the town of Petersburg, with the United States or Federal army facing their opponents, also behind strong entrenchments. The Federals had about 120,000 men of all arms, and the front covered

a distance of nearly twenty miles. A few days after our arrival General Grant assumed the command of all the troops. These were made up of the army of the Potomac under General Meade, a large division of cavalry massed under General Sheridan, together with the 24th Army Corps.

On the morning of the 24th of March 1865 the decisive campaign of the war commenced. The general idea was to attack the works immediately in front of Petersburg, and, while the enemy was held there, to envelop his right or west flank with cavalry, and so cut off the whole army from the Confederate States. The numbers of the Federals were so much larger than those of their opponents that there was every chance of success. Besides superiority in numbers, the Federals were well clothed, well fed, and in good spirits; while the Confederates were partly in rags, all on short rations, and in a desponding mood. Several times during the campaign bodies of twenty to a hundred would just simply give themselves up. "Secesh was played out," they said, and the men had no heart to continue the war.

The whole organisation of the army and the method of fighting was profoundly interesting to a European soldier. Here was an army, conducted on a purely democratic basis, with a discipline as efficient as that of the feudal monarchical hosts of Germany, and a system of tactics invented to meet conditions of warfare unknown in Europe. The whole of this part of Virginia is covered with a dense growth of pine-trees, and an undergrowth so thick that the skirmish

lines could often only see each other one or two hundred yards apart. European generals always avoid forests, while the drill and equipment of their armies is all adapted to fighting in the open. A "long, thin, red line" could not be deployed in a wood; and the lance, which is the "queen of weapons" on the plains of Hungary, is useless in a forest. But here, within three years of the outbreak of war, the adaptive genius of the American race had developed a new method of fighting large armies in thick country in the following manner:—A straight, strong, though loosely formed, skirmish line was pushed towards the enemy, and a breastwork of wood run up within an hour. Then the advance was continued, and a second breastwork constructed. If the line gave way during the advance, the first breastwork usually served to break the onslaught of the enemy. The loss of life was, however, very great; but the numbers who recovered from their wounds was larger than in any previous campaigns.

This was partly owing to the climate, and partly to the organisation of the medical service. I had several opportunities of witnessing the procedure in the field hospitals behind the skirmish line. Wounded men were brought in and laid on a litter of fresh cut pine tops, so that their immediate requirement could be met. They were then transferred to the rear into temporary hospitals, run up of freshly split pine planks, so that from first to last they were in a constant atmosphere of resin and turpentine. Antiseptic surgery with carbolic acid spray was then

unknown, but the aroma of pine-trees replaced the erysipelas and gangrene-tainted air of an ordinary hospital ward with the happiest results.

The spring and autumn climate of Virginia is also nearly perfect for white men, apart from the specific influence of fir-trees. This was the very antithesis of what will be described in another chapter on Fiji, where the climate alone develops lock-jaw or *tetanus* from the slightest contusion.

During the night of 1st April which preceded the last bombardment of Petersburg it rained heavily, though the previous day had been fine but cloudy; and the following day was similar in character. At the time I was entirely absorbed with the military events, and had then given very little attention to the subject of meteorology, but have often wondered since whether this was an illustration of what has often been commented on—the influence of battles on weather. During the naval wars at the commencement of this century it was always asserted that the heavy cannonading of the ships made the wind drop, and that rain sometimes fell afterwards. I once read a statement in a newspaper that the battles of the great rebellion of 1861-65 in the United States had frequently developed rain, and I think the writer went so far as to advocate the discharge of large numbers of guns to bring rain in time of drought. The question is one which from the nature of the subject must always be difficult to solve, but I am certain that we must look to the surroundings of wind and pressure to ascertain how far the

concussion of explosions might modify the weather on any particular day. In a good strong British winter gale the surrounding forces are so great that one cannot believe that any local influence could modify the general weather. But when, as in the Mediterranean and the middle portion of the United States, differences of pressure are small, and if still further the shape of the lowest pressure is such as nearly to develop rain, then it is quite conceivable that great concussion may affect the weather. How it does so we cannot say, but there is no inherent impossibility in the idea. Meteorological observations were of course suspended in the United States during the war, but from the French charts for the Atlantic Ocean on that day I find that there was a loop of low pressure lying then over Virginia. This would account for the cloudy sky and generally broken weather which we had experienced since the commencement of the campaign; and at all events the surroundings were such that, if it is possible, a battle might have affected the weather.

When I returned to Montreal in April, winter was gone, and spring already far advanced. I had missed the rapid thaw when the streets are knee-deep with mud, and the great ice shove, when the St. Lawrence breaks up and piles floes of ice ten feet high over the wharves of Montreal.

Spring comes on with a rapidity which an Englishman can scarcely realise. A few weeks suffice to turn a white desert into a green and smiling country, while some humming-birds which come up for

about a fortnight in May give a curious semi-tropical aspect to the woods.

Summer is very hot at times. For one week in the month of July the thermometer never fell below 100° F. in Montreal, and one or two days temperature rose to 103°. Still the heat was not very trying owing to the extreme dryness of the air; custom proscribed working in your shirt sleeves, and business was never suspended. All through the summer the weather was tiresomely fine. I do not know anything so monotonous to an Englishman as to wake up day after day in Canada, and see nothing but the same cloudless blue sky, the same hazy horizon, and the same mirage over the river. It was quite a relief when an occasional thunderstorm brought a little cloud into the sky; or when more rarely the wind went round from the S.W. to the N.E., and rain fell in front of a small summer cyclone.

Once during this summer, while we were out shooting at a place called Chambly, near Montreal, the air for more than a week was so thick with a peculiar kind of dry haze that our men could scarcely see the targets at 800 yards in the middle of the day. We heard afterwards that several square miles of forest were on fire more than fifty miles off in the direction of Kingston, which would be exactly to the windward of us. These fires are very common during the dry weather, and the so-called dry fogs which have sometimes been reported in Europe are probably the product either of distant fires or of distant volcanic eruptions.

The American fall, or autumn, is justly celebrated

for its beauty. The tints that the leaves of the trees assume, especially the maples, are singularly brilliant and variegated. The hues are best developed after a white morning frost, which seems to partially kill the leaf, and a sequence of colour can sometimes be traced from the bright natural green of the leaf through yellow and orange to the bright red of the dying portion of the foliage. The beauty of the season culminates in the few exceptionally fine days that constitute the so-called "Indian summer" during the last days of September. This period is one of a large class of spells of good or bad weather which recur at the same time nearly every year in spite of the ever-changing variable climate of the Temperate Zones of the earth. St. Luke's little summer, about 18th September, and St. Martin's summer, about 11th November, in Europe are similar periods. Their origin seems to be somewhat as follows:—The variable climate of the Temperate Zone is the rough product of the passage of a perpetual series of atmospheric eddies of good and bad weather; at certain times every year these eddies tend to take the same form and sequence, and therefore the same weather is apt to recur about the same day of each season. The old theory that the ice forming in the Arctic Circle about the end of September liberated so much latent heat that the Temperate Zone was warmed thereby, may safely be dismissed, now that we have a better knowledge of the true nature of weather changes from day to day.[1]

[1] For full details of hot, cold, wet, dry spells of weather, see Abercromby, *Weather*, p. 312.

In the month of September I made another short trip to the States, returning home by Quebec and the Lower St. Lawrence.

From Quebec we ran for a four days' trip to Tadousac, a small watering-place at the mouth of the Saguenay River, some 150 miles down the St. Lawrence. The scenery is very striking; the Saguenay runs into the St. Lawrence between perpendicular granite cliffs 1500 feet high, topped with stunted fir-trees. A little farther up the ground falls, and you come to the small group of houses which constitute Tadousac; located on undulating ground, covered with great boulders of coarse grained granite or gneiss, with here and there a blasted stunted pine to show that we are near the northern limit of trees. The whole effect is very striking, and heightened by a sort of Arctic chill in the light autumnal breeze. A little north of the mouth of the Saguenay, the latitude of permanently frozen soil comes farther south than at any other point of the earth's surface. We are unable to give any explanation of the fact, but one ought probably to look at the nature of the soil and the direction of the prevailing winds. Eastwards from the Saguenay, in the latitude of the river Loire, to the Labrador coast, the land is mostly treeless and barren, but higher up the river there are very valuable forests, and in the far north-west, along the Mackenzie River, pine-trees grow north of the Arctic Circle. The distance southwards of the Pole to which permanently frozen earth extends, and the depth to which this ice cap of the world is melted by the

summer sun, must depend largely on the nature of the soil. In sandstone rock, which is only a moderate conductor, both the depth of the cap and the range of summer thaw will be small; but in a mass of porous moss, where both evaporation and infiltration can take place according to circumstances, the depth and seasonal range will be large.

In the month of November there was a Fenian scare, and the battalion was sent off on a few days' notice 600 miles up country from Montreal to the City of London in the province of Ontario. The chief part of that province lies in a peninsula formed between the great lakes of Huron, Erie, and Ontario; and it was very striking to see how the neighbourhood of these large masses of water developed the amount of cloud in the sky. One seemed to have got into a new climate, and to have passed from dry cloudless weather into a region of overcast skies and occasional rain.

There are more Indians in Ontario than near Montreal. The manner in which the curly hair of the Englishman grows lank among his descendants in the United States, and the similarity of this trait to the hair of the Red Indian, has often been remarked. There is little doubt that this is partly due to the change of the home of the race from a damp to a very dry climate, and partly perhaps to other causes. Anybody who goes to a dry climate even for a short time notices an alteration in the character of his hair, and the brittleness of his nails, so there can be no doubt that the continued effect of this influence for

even two or three generations might permanently alter one feature of the race. The more rapid decay of the teeth among citizens of the United States is probably due to the same extreme dryness, for at the Cape of Good Hope a similar deterioration is found. It would be a curious investigation to try to discover whether the typical American twang is due to any climatic influence on the nerves and muscles which control the voice. In our second voyage round the world we shall see how the hair of the English race has assimilated in Australia to that of the natives. In that country, too, there is extreme dryness, but in many other ways the climate of Australia is very different to that of the United States. It is doubtful whether change of diet has anything to do with alteration in the hair, for nothing can be more different than the food of the mutton and potato-eating Englishman and that of the grub, berry, and offal-feeding native of Australia.

In the month of December I made a trip to the far-famed Falls of Niagara. Winter had commenced then, the ground was covered with snow, and long icicles hung all round the sides of the falls. The sky above was the dull uniform gray pall which is so characteristic of snow in every climate; many of the hotels were shut up, and the tourist traffic had ceased for the season.

Niagara is one of a class of waterfall of which there are few examples to be found anywhere. The typical waterfall occurs in mountainous countries, where a comparatively narrow stream falls down a

great height, amidst more or less imposing surroundings. But Niagara is something very different.

The whole of the surrounding country is flat, but a broad river, three-quarters of a mile across, flows rapidly down, and then suddenly, without any apparent reason, the water is precipitated 160 feet into a ravine or cañon. There is no step or escarpment to suggest such a sudden descent of the water, for the ground is nearly the same height above as below the fall. The ravine or gorge is being slowly eaten backwards, and attempts have been made to estimate how long the river has been cutting its way back from Lake Ontario.

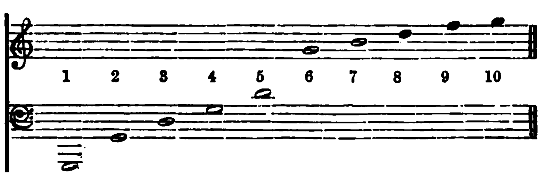
At this season the water was very low, and did not seem to be more than three or four feet in depth. The most interesting view was from behind the falls, where a path had been cut under an overhanging lip of rock. People sometimes complain of a breathless sensation in this position, probably from the suction of rapidly falling water; but we did not experience anything of the sort.

The Falls of the Rhine at Schaffhausen are probably the only European analogue of the American cataract, but on a comparatively small scale; and the only other fall in the world, which is properly comparable with Niagara, is the great Victoria Fall of the Zambesi, discovered by Dr. Livingstone. Many years after this visit I had the pleasure of conversing with Mr. J. Scott of Gala, one of the few men who has seen both falls. He gives the palm to the Victoria Falls, as being larger, and set in rather finer surroundings.

Both are of the same type of broad rivers falling suddenly into gorges, without any mountainous surroundings; but while Niagara is 164 feet high and $\frac{3}{4}$ of a mile wide, the Victoria Falls are no less than 508 feet high and $1\frac{1}{4}$ mile, or 2000 yards, across. The country surrounding the Zambesi is undulating, and composed of sandstone rocks covered with thin bush. Three miles above the falls the country is quite open, but hills 500 feet high line the river on either side of the great leap. The water after the fall is compressed into a width of only 200 yards for a distance of about four miles, after which the country opens out again. The mist formed by the precipitation of Niagara into its gorge is a very beautiful feature of the whole; but on the Zambesi the amount of mist is so great that at certain seasons it is impossible to get a good view of the falls.

The noise of the falls is very great, and has usually been designated as a roar; but an American organist claims to have discovered not only the note which the waters of Niagara sing, but also that the tone is such as would be given by a broad organ pipe, whose length was the depth of the gorge below the falls.

With more or less variation of pitch the notes heard everywhere seem to be :—



Just these tones, but *four octaves lower.*

The first note, or ground tone, is so deep that it never could be realised for an instant; but the two tones marked 3 and 4 are heard *everywhere*, with a power that makes itself felt as well as heard. The fifth and sixth notes are perfectly distinct, but of far less power than the third and fourth. And here comes a curious feature, which proves conclusively that Niagara gives a tone and not a roar—a musical note and not a mere sound or noise. The seventh note is the interval of the tenth; and this, at the falls, is of a power and clearness entirely out of proportion to the harmonies as usually heard on an organ.

The ordinary rules for the note given by an organ pipe of any given length assume that the diameter has a certain proportion to the length; but a theoretical correction can be given for any exceptional proportions. An ordinary pipe should be 170⅗ feet long to give the key-note of Niagara; but it is asserted that the proper correction—10¼ feet less—would bring the length down to 160½ feet, or the exact height of the falls.

I cannot attempt to give an independent opinion on these statements, and have been unable to learn the name of the writer. But the conception that the music of Niagara is caused by the air in the gorge vibrating like that in an organ pipe is so interesting that it is worth while bringing the subject before future visitors.

Soon after this I was ordered home on special duty. The voyage was nearly as stormy as in the previous year, and just after leaving Portland we experienced

a characteristic gale of this coast, known as the "Barber." Sometimes with a south-east wind, either from the air being much colder than the sea, or from the ship being in the cold water of the Arctic current, spray freezes in the air. Under these conditions the spicules of ice so formed are peculiarly cutting, and when driven by a gale against the face almost shave the skin off—hence the name. But this is not the worst. When the cold water falls on deck or in the rigging, a mass of ice is formed which gradually makes the ship unmanageable. The ropes won't run in the blocks, the sails become boards, and sometimes the weight of ice in the bows is so great that the rudder is lifted out of the water and the ship will not steer. Small vessels have been even known to founder from the weight of ice piled up on their decks.

There is another form of barber much dreaded by the boatmen of Quebec. When, in early winter, a cold north-west gale commences, the river is relatively so much warmer than the wind that the water steams. This vapour is instantly frozen in the same peculiar spicular cutting form, and with the same unpleasant effects on the skin.

These peculiar features disappeared after crossing the Banks; and after sixteen days at sea we steamed up the Mersey into the port of Liverpool.

CHAPTER II

TO EGYPT: CLIMATE AND RELIGION

TWENTY years after the events narrated in the last chapter I was recommended to take a voyage round the world as much as possible on the sea. With this view I left London on 21st January 1885 on board the Orient line SS. *Potosi*, bound for Egypt, where I intended to stay a few weeks *en route* to Australia. We left England in the calm hazy weather of a winter anti-cyclone, but on entering the Bay of Biscay encountered a typical moderate south-westerly gale of that stormy region. When off Cape Finisterre the wind moderated, and we experienced nothing but fine weather with varying kinds of clouds till our arrival in Egypt. It is a very curious thing how much the chain of mountains, which is called in its western portion the Pyrenees, in its centre the Alps, and in its eastern prolongations the Balkans, divides the system of weather that prevails in Northern Europe from that which gives character to the Mediterranean Sea. The great cyclones which roll in a perpetual series from the Atlantic over Great Britain and Scandinavia seldom extend their influence south of the Alps. On

the other hand, the vicious little cyclones which form over the Mediterranean and work slowly towards the north-east, rarely surmount the mountain barrier that hedges them in on the north, but spend their fury in drawing down fierce blasts from the snowy ranges, and then die out quietly over Italy or Turkey. But it is often asked, Why is the Bay of Biscay so stormy that it has become proverbial and celebrated in Dibdin's song—

> "As we lay, all that day,
> In the Bay of Biscay O!"

This is a little difficult to explain without the use of charts, but may be given broadly as follows. First let us consider how far the Bay of Biscay is really rougher than the surrounding seas. As a matter of fact it is undoubtedly much rougher than the English Channel or North Sea on one side, and more stormy than the coasts of Portugal on the other. But it is certainly no more disturbed than the west coast of Ireland, or than any part of the Atlantic between Valencia and the Banks of Newfoundland. Still, ships going from England to the Mediterranean, or the West Indies, will usually find their passage across the Bay the most disagreeable part of their voyage; and the few survivors of the old wars will remember the discomfort of blockading Brest or L'Orient for months on end in an old 74-gun frigate. More than three-quarters of the weather of Western Europe depends on the arrival of ready formed cyclones from the Atlantic, whose future course depends on the distribution of pressure which they

find prevailing over the continent. When pressure is low over Scandinavia they (the cyclones) mostly pass to the north-east, and do not much affect the Bay of Biscay. But sometimes small cyclones form to the south of these northern storms, and, meeting the high pressure which divides the Mediterranean weather system from that of Northern Europe, are arrested in their eastward course, and often hover about or brood over the bay for several days before their energy is exhausted. In another common phase, high pressure covers all Northern Europe, and then the whole eastward impetus of the Atlantic cyclones is arrested, as the storms beat up against the high pressure like waves against a rock. The peculiar shape of the Bay of Biscay, with Brittany overhanging it on the north, often catches some of these cyclones, and keeps them nearly stationary sometimes for a week together. In either case there are nearly stationary cyclones over the bay, and this want of motion explains another peculiarity of the gales in that district. We do not find there, as farther north, a well-defined storm in which the wind begins about S.E. and veers steadily to W. or N.W. as the cyclone moves on; but the gale blows from the same quarter in which it began most of the time, and falls owing to the death, not to the onward passage, of the cyclone. In fact one may say briefly that the stormy character of the Bay of Biscay is due to its geographical position. The Bay catches and arrests a class of storm that affects neither the English Channel on one side, nor the coast of

Portugal on the other; but the Bay is not nearly so rough as the west coast of Ireland, which receives the full brunt of the great Atlantic cyclones.

From Cape Finisterre the vessel ran along the Portuguese coast and through the Straits of Gibraltar in such a haze, that one could not see the top of the celebrated fortress; and then skirting the south of Spain, steamed into the Naples harbour on the eighth day after leaving London.

A hazy south-east wind—not the true sirocco—filled the air with gray mist, and effectually hid the justly famed beauty of the Bay of Naples. On the left we could just see the outline of the picturesque volcanic cones which line the Bay of Baiæ, while on the right we could make out faintly the form of Vesuvius, with a thin line of smoke trailing from the top of the crater. I have never been fortunate enough to see the mountain in a state of great eruption, but when the violent uprush of steam condenses in a fine mass of lumpy, cumulus-like cloud, and the electricity developed by the friction of the steam against the sides of the crater discharges itself right and left in a sort of artificial lightning, the effect is said to be magnificent. Colonel Stuart Wortley has exhibited some photographs of Vesuvius in eruption which are very striking.

The steamer only stayed a few hours in Naples, and then sailed for Port Said, through the Straits of Messina. About fifteen hours after leaving Naples we came in sight of the volcanic island of Stromboli. This volcano differs from Vesuvius in that the latter

only erupts intermittently, with long periods of repose, while the former is in a chronic state of moderate activity. The appearance of Stromboli is used by the neighbouring fishermen as a weather prognostic. They say that in winter, when Stromboli is more active than usual, rain and wind may be expected; but that when little smoke issues from the mountain fine weather may be looked for. The motive power of every volcano is steam. Water, either intermittently as in Vesuvius, or steadily as in Stromboli, works its way through cracks in the earth to highly heated rock; then steam is generated and eruption commences. In Stromboli the amount of water which can infiltrate to the hot rocks is balanced, as in mines and other subterranean fissures, by the pressure of the air. In fine weather, when pressure is high, little water passes through the fissures; but when the low pressure of a cyclone and its attendant bad weather approaches the mountain, a great deal of extra water is released from fissures in which it has been pent up by the pressure of the air, more steam is generated than in ordinary times, and the volcano erupts with greater violence than usual. The prognostic only holds good in winter time, for then only is rain in the Mediterranean associated with cyclones. In summer there is never wind and rarely rain; if any of the latter fell it would be in a thunderstorm, and as the barometer does not fall materially for that class of disturbance, the equilibrium of Stromboli would not be disturbed. When the mercury moves in a thunderstorm it nearly always rises, but the

effect is very local, and only lasts for a very short time. At Stromboli the eruptions at worst are very mild, and a Scotch firm of chemists have taken the crater and turned it into a natural laboratory.

At daybreak on the 31st January we steamed through the Straits of Messina. The narrow passage, the picturesque villages, and the fine mass of Ætna towering on the right, are very striking. In a steamer one may laugh at the dangers which beset navigators who sailed through these Straits with only sails and oars. In an early stage of mental development people always tell a story of human incidents to explain any striking natural phenomenon. The classical Greeks and Romans described these dangers in figurative language by saying that on one side of the passage dwelt a fearful monster called Scylla with six mouths, each of which contained three rows of sharp teeth. On the opposite side lived another monster, Charybdis, who thrice a day swallowed down the waters of the sea, and thrice threw them up again. Then close to the abode of Scylla lay the island of the Sirens, three beautiful maidens who enticed mariners to destruction by means of their entrancing songs.

The idea of Charybdis is evidently the personification of a dangerous whirlpool which still sometimes forms on one side of the Straits. The idea of the Sirens is less certain. There is a word in Greek—*seirai*—which is said to mean a belt of calms, but some mythologists think that as song is the element of attraction, the legend must refer to some phenomenon of wind. Now curiously enough there is a

remarkable mirage sometimes seen here in calm weather. The images of objects on the coast are shown in the air. Sometimes two images are shown, one inverted, the other in the natural position; and sometimes a great number of images are observable.

In the Middle Ages, when men still believed in the supernatural, but had passed beyond the myth-making stage of mind or speech, they called this the "*Fata Morgana*" or Fairy Morgana.

I should very much like to visit these Straits in summer, and I have very little doubt that the whole symbolisation of the classical story would be obvious if, as I suspect, the whole refers to a dangerous whirlpool on one side and a delusive mirage on the other.

From Sicily we went straight to Port Said, at the entrance to the Suez Canal; and after a few hours spent in coaling, went half-way through the canal to Ismailia. Though the scenery of the canal is flat and monotonous, still there is scarcely any part of the world which is interesting from so many points of view. There is the historic interest of the important events which have happened in the neighbourhood of the canal; the interest which attaches to one of the greatest engineering achievements of modern times; and the interest which surrounds the artificial control of anything so subtle as climate. Before the Suez Canal was made, the desert through which it is cut was said to be rainless; now since the Bitter Lakes have been filled up with water, rain falls on an average eight days in the year at Ismailia. This latter town is a purely artificial oasis in the desert

which was created by cutting a sweet water canal from Cairo to the point where the great canal runs into the Bitter Lakes. Irrigation makes the town green with trees planted at the sides of the streets after the fashion of a French boulevard; but when the supply of water ceases, you pass within a few yards from a civilised town to the sandy, stony desert, strewed with the dried bones of dead donkeys and camels. We left the ship at Ismailia, and were fortunate enough to have a few drops of rain from a heavy cloud during the day we spent there waiting for a train to take us to Cairo. This probably allows us to gauge the manner in which covering a few square miles of desert with water may develop rain under certain conditions. Take the actual day. The general character of the wind and weather were the product of a widespread disturbance, with which Ismailia and the desert had nothing to do. But it has been observed that the amount of cloud and rain generated during the passage of a disturbance depends partially on the amount of moisture on the surface of the ground. Sometimes cloud will form only over streams and damp woods, but not over dry or cultivated earth; and the case might easily occur in which cloud would form generally, but rain would only fall over the moister surfaces. Every rainy disturbance is associated with an ascentional movement, which carries moist air up to a level at which the vapour condenses either into cloud or rain according to the quantity present. No amount of sea will of itself give rain, unless atmospheric conditions are favourable to

the ascent and condensation of the vapour which the water supplies. Peru, which is bathed by the warm Pacific, is as rainless as the deserts of Central Asia; the former has abundant vapour, but no cyclones or thunderstorms to precipitate rain; the latter are swept by endless cyclones, but give off no vapour to condense. At Ismailia when the rain fell the wind was fresh and the sky nearly overcast with broken cumulus or strato-cumulus cloud, and one of the lumps of the former was heavy enough to precipitate a few drops of rain. The general view of the case is that had there been no Bitter Lakes the sky would merely have been cloudy from general causes; but that the presence of a moderate surface of water gave the rising current of air just that amount of extra vapour which made the difference between the formation of cloud only and the precipitation of rain.[1]

Next day we went by train across the desert for about five hours to Cairo. Both here and elsewhere the desert is not so absolutely barren as the name would suggest, for there were always a few bushes of camel thorn.

The road runs along the course of the sweet water canal and passes Tel-el-Kebir, the site of the victory of the British troops over the rebels under Arabi Pasha. Not very far from there one runs suddenly from the light gray-brown sand of the desert into a flat alluvial plain, richly cultivated, intersected by an endless series of small irrigation trenches, and covered with the

[1] For a full explanation of local influence on weather, see Abercromby, *Weather*, p. 280.

blackest of earths. Then one realises the descriptive accuracy of the old name for Egypt, "Khemi,"—in Hebrew, "Ham,"—or the land of black earth, not of black people as the older commentators assert. One also sees what a small country it is, for in the distant west the mountains of the Lybian desert, on the other side of the Nile, appear on the horizon. In fact, Egypt begins as a narrow strip of black earth 500 miles long on either side of the Nile, running from the first cataract to Cairo. Just below that town the Delta commences, and forms the great triangle of Lower Egypt, which is, roughly speaking, 100 miles a side.

A fortnight was spent in Cairo doing the various sights. I was never more disappointed with anything than with the climate of Cairo. One had always been led to expect a genial southern climate, where you could sit out of doors all day. Such, however, was far from being the case during that portion of the month of February which we spent in that city. Not only was there a good deal of rain, but though the sun was hot by day the air was always cold in the shade, just as in the Mediterranean, and there was not a single night in which one could sit out after dinner. The wind was usually from about north, though all the palm-trees have a south-westerly set.

Here I came across an amusing instance of the difficulty of getting information from uncivilised or semi-civilised people. If you go to any meteorological office in the world and ask for information, you can get it direct in a few minutes; but with uneducated people information can only be got incidentally and

indirectly. There is no use asking questions—"an inquirer, who is always inquiring, never finds out anything." I asked our dragoman one day if it ever thundered in Cairo? He said no; but the very next day there was a moderate thunderstorm!

One of the prettiest sights in Cairo was the view from the citadel as the sun set into the Lybian desert. We stood on the platform of the many minaretted mosque which crowns the citadel; below our feet lay the great town of Cairo, reaching from the river to the desert; while the Pyramids, on the other side of the Nile, stood out against the horizon. At sunset the sky was partially covered with small masses of broken cloud, of an ill-defined character. These took up the varying tints in a very beautiful manner, while the Pyramids were projected against a bright yellow glow. The purple after-glow which makes the desert shine again with a weird light was not very strongly developed that evening, as there was rather too much cloud in the sky.

One afternoon was occupied by a visit to the petrified forest in the desert, to the east of Cairo. We rode out on donkeys over a trackless desert, covered with scattered bushes of camel thorn, for about eight or nine miles; when, without any change in the general aspect of the country, the surface of the ground became covered with what looked like common stones, but which closer inspection showed to be petrified pieces of wood. Most of the fragments are small, but in some places pieces of trees three to four feet long have been dug out. The area covered by

these fragments extends over a good many square miles. Botanists say that the wood is mostly that of palms allied to existing species, but I could not get enough detailed information about the wood to form an opinion as to any past change in the climate of this part of Egypt. Our dragoman, Ali Mallouk, however, knew all about it, and tried to tell me the reason in such atrocious English that all I could make out was something about Mahomed, Allah, and a gardener whose plants had been changed into stone. This was true folk-lore,—a story of human incidents to account for a natural phenomenon.

We had a curious illustration of savage superstition on our way home. My friend Mr. German's donkey stumbled and fell. Ali Mallouk was very angry with the animal, which he declared had never fallen before. However, he knew who had cast an evil eye on the beast, and explained how he was going to cure the donkey that evening. The process, as far as we could gather, seemed to consist in getting the smallest portion of the dress belonging to the evil-eye-casting man, wrapping it up in muslin, and then burning the whole parcel. Two days afterwards we met him and inquired how the charm had worked, but were told that he had found the donkey had a loose shoe, so that there had been no occasion to burn anything.

A very striking feature in the faces of the people one meets in the street is the number of bad or sightless eyes. This results from the great prevalence of ophthalmia, due in the milder form to climate, in the more dangerous phase to flies. The lighter form is

simple inflammation of the lining of the eye from the irritation of dust or sand with the blinding glare of an African sun. In Morocco, and, I believe, Egypt, the skin all round the eyes is often blackened with charcoal as a palliative. In our chapter on the Himalayas will be found some remarks on a curious significance which attaches to this practice. The purulent form of ophthalmia is a far more acute and suppurative type of the same ailment, which is set up by flies that have come off some putrid matter settling on and infecting the eyes. This type is far more dangerous to the eyesight than the other; and yet one sees in the bazaar children whose eyes are black with flies which neither the mother nor the child will take the trouble to whisk away. Fortunately both kinds yield to proper treatment if taken in time; and here modern science has done a great deal for the soldier. In the expedition to Egypt in 1801, under Sir Ralph Abercromby, a large number of men lost their sight from ophthalmia; but in the expedition of 1884, I was informed by one of the medical officers at Cairo that there had hardly been a case of resulting blindness.

The traveller from Europe enters in Egypt another world of scenery and climate, of man and of thought. Some of the features are common to all Eastern countries, but the combination and surroundings are peculiar to the Land of Ham.

The flat black earth, surrounded by the white desert, and intersected by numberless little irrigation ditches, are quite unique. So also are the creaking

sakia, or irrigating wheels; and the *shadoof*, or bucket at the end of a pivoted pole for lifting water from one level to another, which dot the landscape. The miserable collections of brown huts which make the villages are not very distinctive; but the architecture of the dome-covered, minaretted mosque is characteristic of Mahomedan countries.

The crops in the fields are not so striking; but the date palms—all bending from the south-west—arrest the eye at once as typical of the East. The faces and costumes are also novel: the robes of the men, the baggy trousers of the women, and the *yashmaks* or covers which the latter draw over their faces up to the eyes. Long lines of camels and cranes are also unfamiliar objects; and in addition to all these sights the ear is assailed with the never-ending cry of "BACKSHEESH."

The Egyptians, especially in Cairo, pride themselves on being Arabs; but they are no more Arabs in blood than Englishmen. The face, the gait, the walk all show their identity with the race which is figured in the ancient hieroglyphic sculptures. Over and over again we were struck with the likeness of the scenes in the streets of Cairo to the pictures we had seen in the tombs. Men carrying geese in the same peculiar way by the wings, the same way of house-building, the same water jars, the same features, and the same pose of the figure. The true Bedouin of the desert is quite a different man both in face and bearing, and you cannot mistake him for a moment when you see him stalking through the bazaars. At the

same time, there is little external sign of a conquered race among the Egyptian peasants; their bearing is erect, and their manner courteous but not servile. If it was not for the perpetual begging for *backsheesh*, they would give one the impression of being far more independent than they really are.

But by far the greatest change which the traveller notes when he comes from Europe to the East is the difference of character and temperament that finds its manifestation in religion. Any discussion of the broad differences between the Mahomedan and other creeds is of course out of place in this book; but we wish to show how far certain peculiarities of climate have favoured the development of various religions in the neighbourhood of Syria and Arabia, and how the extension of Islam is almost conterminous with certain very dry regions of the earth.

The development of that metaphysical temperament which is indispensable to the founder of a new religion requires solitude and comparative idleness. At certain times in the history of the world there seems to be a general vague desire for improvement in religious matters, nobody knows exactly how. Then comes the prophet, in the person usually of a half crazy man. It is well known that a man of energy, who is just verging on insanity, can influence men in a way which quieter and more sober persons cannot do; and moreover the very want of balance enables him to see some things clearer than other people. Such men, like the poets, embody the unformed yearnings of a nation, and give definiteness and

precision to the ideas which are floating in the air.

But now where does one find the surroundings of nature which allow men time to reflect, or which permit any individual to find the safety and easy subsistence that are indispensably necessary for meditation? In any climate among the lowest races men are too much occupied with procuring food to have time or inclination for anything else. Each man has to chase his own game and pick his own berries, so people in that stage of civilisation have little or no religion, among other good reasons because the necessary conditions for thinking are impossible among them.

In many tropical climates, like the South Sea Islands, subsistence is so easy that men need not work; they have only to plant a few bananas, and pick cocoa-nuts when they want them. No religion could however grow there, as the islands are too crowded for solitude.

Neither could any creed have its birth in the jungles of South America or in the forests of the Malay Archipelago. Food is not always easily got, and if so will not keep well in that climate; the heavy rainfall almost necessitates house building, for rocks and caves are uninhabitable; and practically in such countries it is hardly safe to live alone.

Then in the northern plains of Europe, Asia, or America, the struggle for existence is too severe for a meditating man, even when a nation has passed the stage of absolute barbarism. The long cold winters

require care and forethought to store up food, and people usually rather huddle together for the sake of warmth.

But in the dry deserts of Syria and Arabia we find all the requirements for the development of religious thought. The struggle with the forces of nature, compared with either that against the rank forest and savage beasts of the tropics, or the cold winter of northern climates, is so easy, that nations in those dry regions appear to have been the first to establish a tolerably organised state of society, where men have leisure to think, and to consider how far the welfare of the community can be improved.

There are numberless caves and holes in the rocks in those dry climates, where a man can take a bag of grain which will keep him for weeks, and live in comparative comfort and safety. By day he hides from the fierce glare of the sun in the recesses of his dwelling; by night he meditates in the open air. Sooner or later this course of life tells on a man whose constitutional temperament, as shown by the love of thinking and of solitude, is morbid and unhealthy. The starvation, the asceticism, the absence of society, often the self-inflicted penance, the long-continued brooding on the same ideas, the in and in thinking, more or less derange the mind. Very often he sees visions or hears voices, both of which confirm his prevailing bent of thought; and then the manufacture of a prophet is complete. In early states of civilisation the morbid hallucinations of a low nervous health, just short of absolute insanity, are

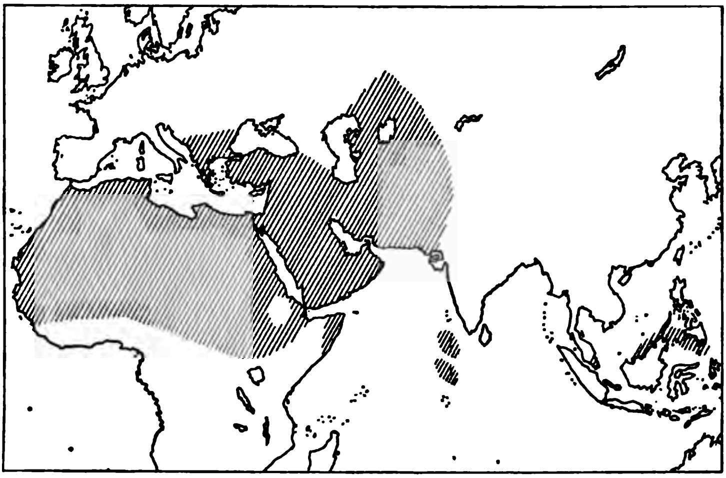
always considered as signs of inspiration, and the patient is looked upon as one to whom the *vista* of a new spirit world has been suddenly opened. This belief, when added to the singleness of purpose and carelessness of personal gain or danger which characterises persons in that state of mind, gives a man ascendency over a superstitious and fanatical race. Hundreds of such men under various names have had, and still have in some countries, a greater or less local celebrity; and once perhaps in five hundred years a prophet arises, either of greater force of character, or whose ideas embody the desires of a large number of people, who becomes the founder of a new religion.

Such a one was Mahomed, an epileptic in youth, an ascetic in middle life, a debauchee in his old age. A seer of visions who undoubtedly believed in his own inspiration even if he did not scruple to aid his influence by trickery; but one who saw clearly why Christianity had failed to rescue his countrymen from a very gross form of idolatry, and who embodied their aspirations for betterness in a form which has taken such a firm hold of a large portion of mankind, that the lapse of 1200 years has failed to shake their belief in the founder.

Buddha lived in a part of India where, though there is a short wet season, the greater part of the year is dry; and the climate and intellectual development of the people filled the country then as now with prophets or fakirs. The history of Buddha is that of a man going partially insane—first morbid hypersensitiveness of emotions, then the perversion of

healthy desire; finally long fasts and solitude till all natural feeling was lost and the whole being absorbed in certain abstract half-religious, half-metaphysical speculations.

So far it is easy to see why so many religions have had their birth in the dry countries of the world, but it is not so easy to explain why the area now covered by the creed of Islam is with only one

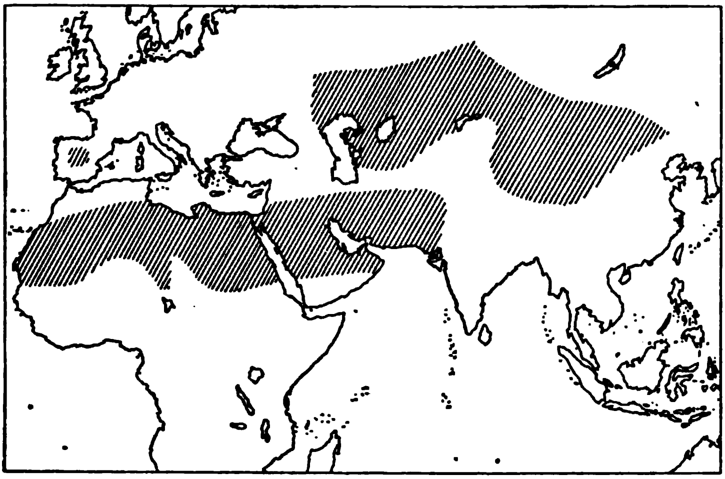


MAP OF THE AREAS OF MAHOMEDANISM.
The shaded districts show the extension of Mahomedanism.

important exception confined to dry climates. Here we give a diagram of Mahomedan countries, and a diagram of countries whose rainfall is less than 10 inches. Starting from Arabia, the only dry country to which the religion of Islam did not extend is the desert of Mongolia; and the only important extension of the creed into wet countries is in the Malay peninsula and a fringe of coast-living people under Malay influence in various islands of the

Malay Archipelago as far east as Mindanao. The Mahomedanism of these people is, however, very mild compared to that of Asia: they are neither fanatics, nor do they build imposing mosques.

On the other hand, Mahomedanism has never made any progress either in the stormy countries of Europe, or in the dense tropical jungle of Africa south of the Sahara desert. In India a Mahomedan is only



MAP OF THE RAINLESS AREAS OF AFRICA AND ASIA.
The shaded districts show where the rainfall is less than 10 inches in the year.

there as the remains of a conquering race; and in China he has made little way against the Buddhists and Confucians.

Whether this distribution of a great creed is the result of chance or of some deep connection between the tenets of that religion and climatic influences I cannot say. Dry countries are no doubt generally treeless, and so far easy of conquest to a nation that

spreads religion with the sword, but still the relation is so remarkable that I have thought it well to bring the matter forward, and perhaps some one who has intimate knowledge of the spirit of that faith may be able to say how far the practice of Mahomedanism is adapted to the climate which gave it birth.

CHAPTER III

TO AUSTRALIA: VOYAGES FOR HEALTH

WE started from Suez on the 20th of February 1885, on board the magnificent steamer *Orient*, for Australia. This voyage is one of the most interesting that can be made by those who desire to look at Nature as she manifests herself in climate.

The change is great from the dry air and sandy deserts of Egypt to the steaming atmosphere of the equator; the brief peep one obtains of lovely tropical vegetation on the coral island of Diego Garcia again contrasts with the other arid land to which one comes, where a burning sun scorches up the grass, and one finds one's self surrounded by strange trees, plants, and animals, on the plains of the city of Adelaide.

As soon as we got away from Suez the climate began to change. The air at Cairo was always sharp, and the nights were chilly, as in the Mediterranean; but in the Red Sea the atmosphere was hot and baking, and the ship was stopped to send the doctor on board a homeward bound steamer, just in time for him to see a man die of sunstroke.

The next day we entered the Tropics with a north-west wind under a cloudless sky. But though the air was free from vapour, the white blue of the sky and the hazy horizon showed obviously that some matter was floating in the atmosphere; and when the sun was set a strange brick-red glow suffused the whole of the western sky. This colour is never seen in the open sea, but often on very dry land, where as here dust and sand fill the air with light particles.

Before we enter the cloudland of the Tropics it may be well to explain the meaning of the one or two technical words for cloud forms that we are compelled to use rather frequently. By "cirrus" we mean the light, fibrous, or hairy-looking clouds which generally float at a very high level; "stratus" is flat thin cloud; and "cumulus" rocky, lumpy masses of condensed vapour. There are also several mixed forms that are very common. "Cirro-stratus" is a mixture of hairy and flat cloud in the form of a thin broken sheet, sometimes cross-fibred like a web of gossamer, sometimes composed of much heavier masses. "Cirro-cumulus" is a conventional name for the lovely fleecy sky often seen, like that in the engraving on p. 163; and "strato-cumulus" describes a mixture of flat and lumpy cloud, which is very well delineated on p. 172, and in the photograph which forms the frontispiece.[1]

On the fifth day out from Suez we sighted Aden,

[1] Photographs of the ten leading varieties of clouds, and full explanations of the method of determining their motion, are given, Abercromby, *Instructions for Observing Clouds by Sea and Land.* London, Edward Stanford.

and after running to the eastward for twenty hours to round Cape Gardafui, turned to the south-east, and headed towards Diego Garcia. We kept for four days on this course, enjoying to the utmost the delightful weather of the north-east monsoon. Imagine a pleasant breeze from the north-east, a warm air that rarely gets much above eighty degrees, and that is never chilly even in the early morning; a climate in which you can sit on deck all day and all night without wraps and yet never be oppressed by the heat; a dancing sea, and a blue sky dotted over with beautiful small rocky clouds, and you have a faint idea of the charm of this part of the voyage.

We shall meet with these cloudlets so often in the course of our travels that we may well pause a moment now to notice their special character. Essentially each cloud has a small flat base and a little rocky top, which does not usually rise straight up, but looks as if it was blown forwards. In one particular direction only the cloud appears to rise straight up, but every cloud on the one side of this seems to be blown forward to the right, and every cloud on the other side to the left of its base as in the accompanying illustration.

But strange as it may appear at first sight, the point from which the clouds seem to be blown forward never indicates the direction of the wind, either on the earth's surface, or in the strata where the clouds themselves float. We are looking in the engraving towards the SOUTH, and one might think that the clouds were being driven from that quarter,

but they are really ranged lengthways from SOUTH to NORTH, and float, nearly broadside on, in an easterly current over the north-east monsoon which ripples the surface of the sea. The simple reason for all this is fully given in Appendix I, so that all we notice here is the universality of this beautiful and characteristic "trade cumulus" in every region where trade wind or monsoon blows. Strange to say, the special features of trade cumulus do not appear to have been

TRADE CUMULUS.

noticed by any previous traveller whose works I have read.

But if the sky is beautiful by day, how much more lovely is it when the sun goes down. We are surrounded by two changing panoramas of colour. One brilliant series over the setting orb, another paler, but more delicate, on the opposite horizon.

Just as the sun sinks out of sight a patch of pearly-white light grows on the glowing sky some twenty degrees directly above him; and exactly opposite, the top of a rosy arch appears low down on the

eastern horizon. This white patch has no well defined outline, but the peculiar clear transparent whiteness contrasts strongly with the surrounding blue sky.

In about a quarter of an hour the patch of pearly white becomes tinged with purple, while the sky below assumes a bright canary yellow colour of a brilliancy unknown at home; and turning round we see the gray shadow of the earth, surrounded by a pale fringe of rosy pink, rising high in the eastern heavens.

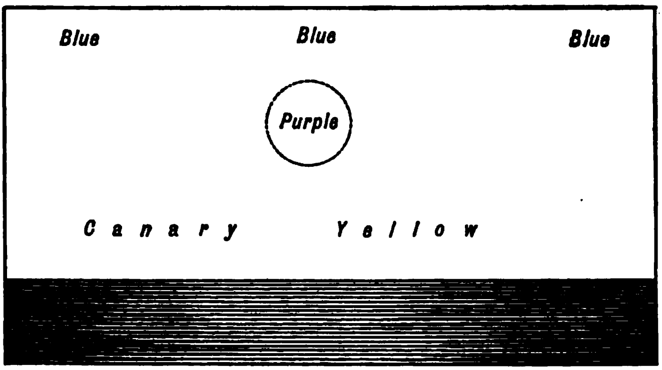


DIAGRAM OF FIRST TROPICAL AFTERGLOW.

The engraving shows the position of the colours at the commencement of this first after-glow, but the purple patch shades off into the bluish-yellow surrounding sky more gradually than the dotted line we have drawn round the word "*purple*" might suggest. A few minutes later the purple light flushes out strong, and the sea, the ship, the rigging, all burn with the fascinating light of a tropical after-glow.

The accompanying sketch shows the position of the so-called anticrepuscular or anti-twilight arch, opposite the setting sun. The dull leaden gray

sky inside the curve being really the shadow of the earth on the sky. Soon the glow fades,—it does not set,—and an orange band, shading off through green into the blue of the sky overhead, lies on the western horizon; while on the opposite side the dark arch has disappeared, but the summit of the rosy fringe is replaced by a pale purple patch above more green sky. And now the clouds take up the pageant which has left the earth. A sheaf of pink crepuscular rays springs up like a fan from

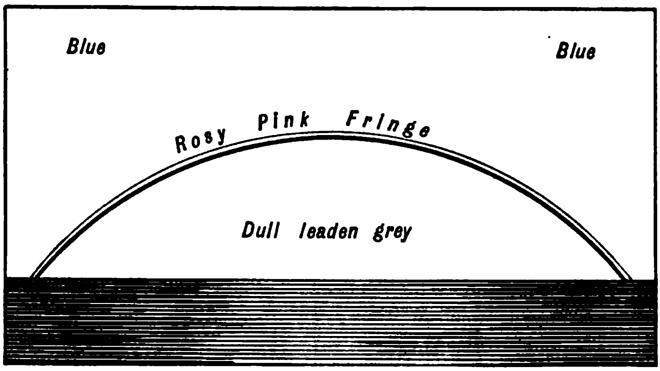
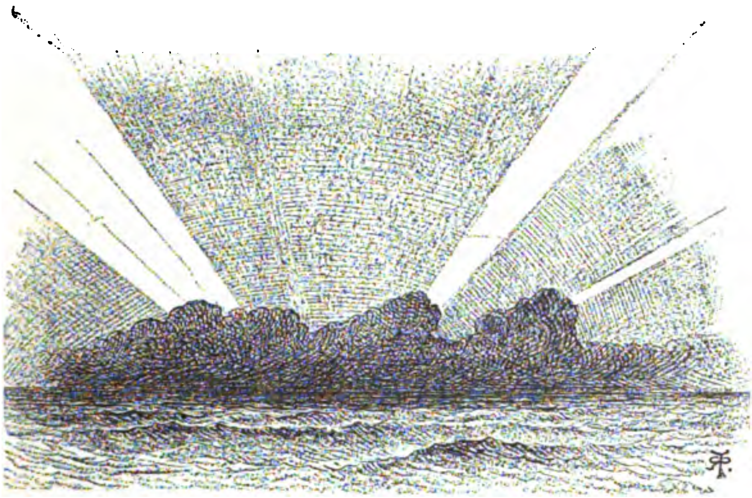


DIAGRAM OF ANTI-TWILIGHT ARCH.

the sea, converging towards the sun's place below the horizon; and the contrast of their rosy hue with the green sky between them is indescribably beautiful. In the illustration, which is sketched from one lovely display, the white represents the pink rays, and the light shading over the clouds the green interspaces; but neither pen nor pencil nor brush can reproduce either the transparency of the colour, or the brilliancy of the sky. The lower cumuli assume successively every shade of pink or lavender or brown,

while any higher flecks of fleecy cloud seem to hang like pink grapes in the glowing sky. Soon these colours fade, and for the next twenty minutes darkness appears to be gradually coming on; but suddenly a second purple after-glow—grayer or more lavender-tinted than its predecessor, and rather lower down in the sky—flushes up strongly above the western horizon. One might think for the next six or



CREPUSCULAR RAYS.

eight minutes that the light was returning, but the glow gradually dies again, and nothing is left but a small arc of deep red light that only disappears finally about eighty-one minutes after the sun goes down.

These rays are the shadows of clouds projected across the sky, and the apparent divergence from the sun is only an effect of perspective.

It seems to us that the shortness of twilight in the Tropics has been exaggerated. Of course there is no

gloaming as at home, and it very soon gets too dark to read; but if we look at the time it takes before all brightening has gone from the western horizon, we find that about an hour and twenty minutes have elapsed.

The *Orient* crossed the Line on the 1st of March; and immediately the weather began to change, for the wind drew round from north-east to the north-west; and though still blowing lightly, the ship began to roll under the influence of a westerly swell. The sky too began to be more threatening, for cirro-stratus gathered over the usual low cumulus, and by the time we got to Diego Garcia, two days later, we were fairly in the wet squally weather of the north-west monsoon. We found the heat much more oppressive than before, for the wind was astern, and gave no draught through the ship, so that even with the steam punkahs going, the thermometer rose below decks to 87°, and the dampness of the air increased the feeling of discomfort. The old navigators used to call this the cross monsoon, because on the road to India they met here a westerly wind, intermediate between, and crossing, as it were, the north-east monsoon and the south-east trade.

The thirty hours that the ship stayed for coaling at Diego Garcia afforded a pleasant interruption to the long voyage from Aden to Adelaide, and especially when spent among such novel and interesting surroundings. The first glimpse of a coral island is always a sight to be remembered from the strangeness of the aspect, and the contrast of the scenery to that of any other landscape in the world.

Diego is a typical coral atoll, in the form of an immense horse-shoe, open towards the north-west, but not surrounded by a fringing reef. The ring of land that forms the crescent varies from thirty yards to a mile across; while the lagoon, or calm lake within the atoll, is fourteen miles long and hardly four across in the widest place. Every available spot is planted with cocoa-nut palms, which form a circle of green rising out of the ocean. As the ship approaches, the tops of the palms first show above the horizon before any land is visible. A little later, surf is seen breaking on the outside of the reef, with an opening in the line of foam that marks the entrance to the lagoon. We steer for this, and can soon admire the full beauty of the scene. Every wave as it curls over the white coral assumes a most lovely bright green hue, partly through the reflection of a vertical sun from the limestone of the reef underneath the sea, and partly from a slight turbidity of the perpetually churning water. The huge steamer rolls heavily as she threads her way through the intricacies of the gap, and in a few minutes she passes from the tossing sea into the calm shelter of the lagoon.

We landed early and with considerable difficulty to see the strange island; for even inside the shore is lined with reefs, and there are so many sharks about that it is hardly safe to get into the water. A strip of dazzling white sand skirted the water's edge, and we had to surmount a curious wind-raised bank of sand, some twelve feet high, so overgrown with a

green creeping shrub, as to be only passable where a regular track had been cut. This brought us to the lower level of the island proper, on which the cocoa-nut palms grew, where the light covering of sand was so thin that the fingery nodules of dead coral, which really compose the reef, project through the soil among the roots of the trees.

One of our party climbed with some difficulty up a tree to throw down a few nuts, and then hot, thirsty, and breakfastless we had to try Robinson Crusoe-like ways of opening them. No one who has not tried it, can imagine the difficulty of getting through the three or four inches of fibrous husk that surrounds a green cocoa-nut without a hatchet or even a stone axe. However, after much hammering with wedges of coral, we managed to open a few, so as to suck the cool milk inside. The white of the nuts was bad and tasteless, and is said to be very unwholesome in this unripe stage.

The night we spent at anchor was anything but cheerful, for most of the ports had to be shut to keep out the dust of coaling, and the weather was so squally and showery that it was impossible to sleep on deck. The coolies who put the fuel on board were a most miserable mixed lot of Malagasies, Somaulies, and half-castes of all kinds. They were constantly striking, once for food, another time for beer, and invariably knocked off work during the squalls of rain, while our own white stokers coaled the ship from the other side all night without intermission. It really looks as if the inferior races were

more easily cowed by weather than men of a higher stamp.

A quantity of pumice-stone was floating about in the sea near Diego, and we were assured that this had appeared for the first time soon after the great eruption of Krakatoa in the Straits of Sunda, more than a year before our visit. But we also saw once or twice during this voyage a far stranger product of the great volcanic explosion, in a curious pink halo, or rather a continuous circular disc of pinkish blur, surrounding the sun to about the same distance as the simple coloured ring of an ordinary halo of 22° diameter. This strange light was first seen in the Sandwich Islands a few days after the great catastrophe in Java, and the laborious investigations of committees which sat in London, first under the auspices of the Royal Meteorological Society, and afterwards of the Royal Society, have proved most conclusively that this blur was caused by minute particles of volcanic dust floating in the air at a considerable height above the ground. It is remarkable that such light particles, which are really tiny fragments of volcanic glass, should remain floating so long without falling down; but extremely small light bodies are so much retarded by the friction and viscosity of the air that the effect of gravity is almost entirely counteracted.

One day's steady steaming after leaving Diego Garcia took us out of the showery north-west monsoon into the calm belt of the doldrums, which was as far as 12° south of the Equator at this season. The weather here was very different from what we had

been led to expect. Instead of an oily calm and torrential rain, we sailed for a whole day under a beautiful sky, scarcely half covered with small detached masses of cumulus, though at sunset some fragments of rainbow on the horizon indicated a few far-distant showers, and lightning flickered from time to time among the clouds after darkness had set in. There was no abrupt meeting of contrary winds, but light breezes blew alternately from the north-west or south-east, with perhaps a few minutes of calm between them, till at last the latter prevailed, and we were fairly in the south-east trade. But though the surface winds were variable the clouds showed that for the last two days the higher winds had been coming steadily from the south-east, and it seemed as if the north-westerly current gradually thinned out and disappeared without any violent conflict.

All through the north-west monsoon we succeeded in making some very interesting observations on the motion of the clouds between the Equator and the doldrums, which throw an entirely new light on the nature of atmospheric circulation in that region; but as the results are fully given in Appendix II, we need not do more than allude to them here.

The westerly swell was so heavy one day that we thought there might be a hurricane in the neighbourhood. But the sky never threatened, and fine weather continued. I was very much disappointed in this, as there were several points connected with these storms which I wished to see myself, and it was all the more tantalising as the ship which followed us a week later

encountered a small hurricane nearly in the same place, and had every one of her boats blown clean out of the davits. There is very little real danger in a large well-found ship, and there are some things which cannot be described, of which, from all accounts, the wind in a hurricane is one.

When fairly in the south-east trade we experienced another rather sudden change of climate, for instead of a hot, steamy, following breeze we now drove into a fresh head-wind, with a comparatively cool dry air. The general appearance of the sky was precisely analogous to that in the north-east monsoon, with the same small cumulus and curious bending of the heads of the clouds in one particular direction; but, leaving the doldrums out of the question, the north-east monsoon is generally hotter and damper than the south-east trade.

This weather lasted till Cape Leeuwin—the south-westernmost point of Australia—was rounded, ten days after leaving Diego; and then, while running across the great Australian Bight, we got fairly out of the south-east trade and into the westerly winds of the southern hemisphere. The quality of the air and the appearance of the sky were both changed; the one had grown softer, damper, and less bitter, while the other presented the more irregular aspect that we are all accustomed to at home.

As we approached Adelaide, a shift of wind to north-east accompanied one of the most striking skies I have ever witnessed. The whole heavens were covered with heavy fleecy cirro-cumulus and cirro-

stratus, and though the same general character persisted throughout the day, the details never remained the same for a single instant. Sometimes the hairy fibres of cirro-stratus would gather for a moment into woolly lumps, and these in turn would fly off into hairs; at other times the under surface of the clouds would droop down in festoons, from which rain or snow seemed to fall for a certain distance and then to evaporate into thin air. There was a look of seething unrest about the sky that belied our calm sea, and a few days later, when ships began to arrive from the south, we heard that they had experienced a very hard gale about three hundred miles from us. In Adelaide, on the contrary, they had one of the most oppressive days of the season, with a hot wind and sultry air, in which the thermometer rose to 94° in the shade.

The steamer scarcely stopped twelve hours at Adelaide, but we had plenty of time to see the town. What strikes one first on landing in Australia is the extreme barrenness and aridity of the ground. There is nothing bright or green—it would never have been called an emerald island—and the dark-foliaged trees appear to grow out of brown earth. I landed with an old squatter, and asked him where all the grass was, for which the country is so famous. He laughed, and said that all the ground that looked so brown was really covered with dry grass. This was really so, for we were now—on 19th March—at the end of the summer drought, and the grass had been turned into a sort of natural

uncut hay. Curiously enough the first rain destroys this forage, and the sheep do not thrive so well till a fresh crop of green has sprung up. One is so accustomed to hear of Australia as a pastoral country that it is hard to realise how dry it is, or how poor and thin the grass grows. At home we think how many sheep an acre of good meadow-land will feed, and find probably that three or four will fatten well on that amount of grass; but in Australia they reckon how many acres will be required to feed each sheep, and the area may run from three up to seven acres, or even more in some places, for the keep of a single animal. New Zealand is intermediate, for there an acre will often carry two or three sheep. It is all a matter of rainfall, and of tolerably continuous rainfall too; for five or six wet months are no use if they are to be followed by six months of drought, when every green thing is burnt up, and there is difficulty in finding water for the flocks and herds.

The town of Adelaide is built like a chess-board on a dusty plain five or six miles from the sea, and is like any other town that has been built by English colonists. The real interest of the place lies in the novelty of the trees and plants. The prominent feature in every Australian landscape is the gum-tree. There are really about fifty species in different parts of the country, but they all agree in their ugliness. The leaves are so small, the branches so ragged and straggling, the bark so rough and untidy, that one can never admire the tree in spite of its great size. The long thin leaves twist on their stems during the

day so as always to turn their thin edge towards the sun, and so the tree gives comparatively little shade; and I do not think that there is anything more uninteresting than a gum-tree scrub on a sunny day.

These few hours ashore were enough to show that we were in a different world to any that we knew before, and our impressions were strengthened after we arrived at Melbourne some thirty hours later, and left the ship to travel for about six weeks in different parts of Australia.

It is always a little melancholy to separate from the friends one has made on board ship after a long passage together, and to speculate on the fate of those who have come out to push their fortunes. But besides these, there are always some on every Australian ship who travel for health, and these latter are about equally divided between those who go for their lungs, and those for relief from overwork and other nervous ailments. In our company on board the *Orient* we had five of each of these categories. Among the consumptives one nearly died on the voyage, another bad case gained nothing, but the three others all improved in strength. The overworked men improved in about the same proportion, for three of them decidedly mended, though two showed no change in their condition.

Travelling for health is becoming more and more the fashion in England, as the dangers and discomforts of an ocean voyage are now things of the past. Fifty years ago it was very different. If the hen-coops were washed overboard, and the sheep died of ex-

posure in the Bay of Biscay, the lot of even the first-class passengers was very hard. There would be little to choose from in the way of meat, except the change from salt pork to salt beef, with perhaps a bit of salt ham sometimes as a variety. Bread there would be none, only ship biscuit, which an old sailor would carefully tap on the table before putting it into his mouth, to knock out the weevils. No ice for the Tropics, and water often putrid and unwholesome. Clothes hung up in the cabins would be lucky if they escaped damage from the teeth of the rats; and cockroaches swarmed in the berths, even if they did not begin to nibble at your toes. Reading was difficult or impossible at night by the glimmer of a few dingy lanterns, and no light was provided in the sleeping cabins except such as the passengers chose to find at their own expense. No wonder, then, that scurvy, diarrhœa, boils, and fever were of constant occurrence, and that a voyage was looked upon as a dangerous as well as a great undertaking.

But how different is it all now. The style of living on an ocean liner is that of a first-class hotel on shore; and between soup and fish, *entrée*, joint and pudding, the most delicate appetite can find something to satisfy itself. Fresh-baked rolls are on the table for breakfast every morning, and biscuit is never seen except at dessert. Ice is either carried in large quantities, or else manufactured on board; a tankard of iced water always stands on the saloon table in the Tropics, while any other cool drink can be had for the asking. Drinking water is stored in iron tanks, which

keep the liquid sweet; and if that supply falls short, the condenser can distil any quantity that may be required. Rats and cockroaches are banished from the saloon, even if they abound in the hold; and, as a crowning luxury, the electric light makes reading and society as pleasant on board ship as at home ashore.

The great mistake, especially in chest cases, is to put the journey off till the lung is hopelessly gone. Medical men too often send a desperate case away to sea to get rid of a hopeless patient; but this is little less than cruelty. There are numberless comforts for a dying man which cannot be found even in the best ships, and the position of a patient sent out alone without any personal attendant when in the last stages of illness is deplorable in the extreme. It is very different with the earlier stages of the disease. The voyage often allows the lung to heal,—sometimes permanently,—and at all events the chances of gain are so great that any temporary discomforts need not be considered. With cases of overwork it is otherwise, for there is no fatal stage to fear; and though the nerve may be hopelessly strained, there is always a chance that rest with change of scene and surroundings may be very beneficial.

Dr. W. S. Wilson, in his admirable work on *The Ocean as a Health Resort*, has noticed, what I have never seen published before, that sea air has a deadening effect on the nerves; and this is very obvious to any one on board ship. If you were asked to sleep through any single one of the noises on board a steamer in your ordinary bed ashore, you would say

that it was impossible; but when you lie in your berth surrounded by the thrumming of the screw, the splashing of the waves against the sides of the ship, the noise of footsteps overhead on deck, the creaking of the woodwork and perhaps the rattling of the rudder chains, then the cumulation of noise has a deadening effect, and most people sleep very soundly at sea. The open-air life is also very sedative, and Dr. Wilson asserts that the temperature of the body falls nearly 1° below the usual 98·4°. No doubt sudden epidemics of hysteria, and allied ailments, do break out sometimes on board ships that are taking out emigrants, or a detachment of Salvationists, while they are in the Tropics; but these outbreaks depend on extraneous causes which cannot be discussed here, and with proper moral treatment can soon be checked.

There is one class who do not seem to do well on board ship. Every large steamer for Australia takes out one or more men who have been sent away by their friends to try and break them off drinking habits, but usually with very little advantage. There are so many temptations to drink on board, and so many others willing to help, that such men usually end by having their liquor stopped by order of the surgeon. Unfortunately that restriction is very easily evaded, and if *delirium tremens* supervenes, the result is generally fatal. But putting such cases aside there are few nervous ailments which do not benefit by a long voyage, and by the bracing influence of a change of climate, of company, of diet, and of general surroundings.

CHAPTER IV

TO NEW CALEDONIA: CONVICT LIFE

MELBOURNE has been so often described that it is not necessary to give an account of the city here, but the Observatory is worthy of notice. The building is situated near Government House, on an admirable site opposite to that side of the river Yarra where the principal part of Melbourne stands. The establishment is not on a large scale, as very little money is voted for that purpose by the local legislature. Mr. Robert Ellery, F.R.S., has been at the head of the staff for about twenty years, and is now the trusted adviser of the government in all scientific matters. His duties in the early days of the colony were chiefly topographical, in surveying the then unknown territory, and afterwards in directing the astronomical observatory, giving standard time to ships in the harbour, besides rating their chronometers; while latterly a telegraphic weather service has been added to his ordinary duties. A war scare with Russia was raging at the time of our visit; all the Australian colonies were arming themselves, and laying down torpedoes to defend the mouths of the

harbours; so now the organisation of the torpedo defences of Port Philip Head—the entrance to Melbourne harbour—had been added to Mr. Ellery's work, as he was one of the few scientific men in the colony. The patronage of all government *employés* in Victoria till within the last few years was in the hands of the members of the legislature, who, of course, gave everything to their constituents. But this system was found to work so badly, and it was so difficult for members to refuse appointments to unsuitable men, that now all appointments are made by a set of highly-paid and independent civil service commissioners, who lay down certain standards of fitness for every appointment. The commissioners, however, do not feel themselves competent to decide on the fitness of candidates for the observatory, and as a proof of their confidence in Mr. Ellery, they always invite him to furnish them with the name of the man whom he wishes to have in his observatory whenever there is a vacancy.

I was fortunate enough to find him in his office one day just as he was going to issue the daily weather forecast. The reports from a considerable number of Victorian stations, and a few from New South Wales, South Australia, and other Australian colonies, are telegraphed to Melbourne. These are written down on a suitable map by an assistant, who then brings the chart to Mr. Ellery. The latter draws the isobars, and makes his forecast accordingly.

Forecasting is very difficult in Australia, because the kind of rain that falls in that country is associated

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with very minute barometric changes, and the observations at the inland stations are very indifferent. Rain in England is usually associated with a very well-marked diminution of pressure over the whole country, which shows itself at any particular place by a fall in the barometer. But in Australia rain is associated with a peculiar uniformity of pressure over rather small areas, and the barometer at any single station scarcely moves. It requires at best very good instruments and observers to detect these small differences of pressure, and unfortunately many of the Australian stations are defective in both respects. The expense of inspecting the stations periodically is so great, that the directors of the various observatories cannot visit the distant places, and the levels of some of the inland towns have not been accurately determined.

Rain is the all-important factor in Australian weather, for drought means ruin to thousands of men and death to tens of thousands of sheep and oxen. In this, as in many other respects, Australia contrasts strongly with home. In England everything used to turn round the absence of too much rain or flood; the weather can never be too dry to ripen wheat. "There is never dearth under drought," says an old proverb; and in the old days, before the foreign importation of corn, this was literally true. Now there may not be actual dearth after a wet season, but there is always want, and six or seven millions of money have to be sent abroad to buy food for the people.

It is very different in Australia. There everything turns round a sufficient rainfall. In a good year a moderately large crop of very superior wheat can be raised, and enough grass will grow up country to support some millions of sheep. But when the rainfall is deficient the wheat withers, and sheep die wholesale on the up-country stations. I have heard of the average production of wheat in South Australia only amounting to two bushels an acre instead of to fifteen quarters, as it might at home; and of 30,000 sheep dying of thirst on a single run. Then of course the prosperity of the country suffers generally, for the banks cannot get their advances repaid, and naturally refuse to do much business, so that everybody suffers more or less. Men, however, do not starve as they used to do in England before the days of steam and of universal communications, for there is always enough food and water for them, even if the beasts have to perish.

This extreme dryness of the climate at the best of times makes some curious differences in the agricultural usages. Wheat is usually "topped" instead of reaped; that is to say, a topping machine picks the ears off the stalks, without cutting the straw close to the ground. This method enables a man to gather in his harvest much more quickly, for a horse and man can top a greatly larger extent in a day than they could possibly reap. The straw is usually short and poor, and is ploughed in again as it is not wanted here so much as at home. But when the harvest is won the quality is very

good, for the grain is so hard and dry that it ships well, and fetches a very high price in the London market. English wheat is so soft and wet that it would scarcely stand shipment, for it would heat and spoil; but Adelaide wheat actually gains weight on the voyage home, by absorbing moisture from the air. I have been told that if you wash the grain to get rid of the dirt, the lot weighs more after the dust is removed than before. The gain of course comes from the water, which is absorbed by the very dry wheat, being heavier than the dust which is removed.

There is a very striking illustration of what the vegetation of Australia would be like, if the climate were moister, in the celebrated Fern Gully of the Melbourne Botanical Gardens. The sides of a small natural gully are watered artificially by automatic sprinklers, and in consequence the whole is a beautiful dark tangle of semi-tropical jungle, with every variety of tree and epiphytic fern, and of other creepers.

I had much talk with Mr. Ellery about the general features of Australian weather. What strikes one most is the difference in the way the wind goes round here and at home. Here, before an ordinary gale, the wind goes into the north-east, with halos round the sun and a threatening sky, then as the rain comes on the wind turns towards north-west, and has perhaps got round to the south-west before the storm has passed. At home of course the wind backs to south-east before the storm, with halos and a dirty sky, and then the wind veers to south-west with the rain, and perhaps gets up to

north-west by the time the sky is clear again. In fact, there is the same sequence of cloud and rain, but with opposite shifts of wind in the two hemispheres. It is very seldom that a very well defined cyclone crosses Australia; as a rule only the distant influence of cyclones far away in the Southern Ocean is felt.

The journey from Melbourne to Sydney by land, and an excursion from the latter city into the Blue Mountains, enabled us to get a pretty good idea of the general character of Australian scenery. On the whole the landscapes are unpicturesque, for there is the everlasting gum-tree with its ungainly branches, and ragged bark, and shadeless leaves. These gum-trees, or *eucalypti*, are the southern representatives of the northern myrtles, and we often see under them both a fern very like the Scotch bracken, and a heath not unlike some European kinds. A curious bird—whose strange cry has earned it the nick-name of the "Laughing Jackass"—may often be heard in the woods, and sometimes an opossum may be seen in the trees; but the absence of undergrowth renders the forests on the whole dull and lifeless.

The shape of the hills in the Blue Mountains is very peculiar; but the valleys are nearly all dry, and there is rarely a drop of water to be seen. When we were there, at the commencement of the autumn, there was a good deal of cloud, but the shapes and forms of these did not materially differ from those we know so well at home, for we were now quite out of the tropical system of weather.

Many of the hills are named after celebrated

bushrangers in the early days of the colony. On the road from Melbourne we were shown "Morgan's Lookout," where that celebrity used to watch for his plunder; and also the Bank which was "stuck up" by Kelly in quite recent times.

But after all, the greatest interest in Australia is not in the physical features of the country, but in the people. There is little that is attractive in the scenery, or in the cities; and though the naturalist, the botanist, the geologist, or the meteorologist may all find a great deal of interest, the most distinguishing characteristic of the country is the growth of the people under the new conditions of society and civilisation. This I did not go to study; but there is one notable feature which strikes the most casual traveller—I mean the general improvement of manner and bearing, and the absence of drunkenness and rowdyism. No doubt there are "larrikins" in Melbourne, but they are few in number and quiet in comparison to the London roughs. There are two situations in which all the elements of ruffianism congregate at home—a racecourse and a prize-fight. We went to the great Easter Meeting on Randwick Racecourse, and also to a glove-fight in Sydney; and the difference between either of these meetings and what we would have seen in England under similar circumstances was most striking. I did not see a drunken man on the course; and though there was lots of betting, there were none of the class of touting bookmakers who stand on a stool and bellow the odds. If ever you do see a drunken man in public

in Australia, you may be pretty certain that he is a new arrival, who has been sent out of England for drinking habits. Of course there is a great deal of "shouting" and drinking, but to a less extent and to much less excess than at home.

At the sparring-match I sat next a collarless man who had paid five shillings for his seat; and though there was great excitement, there was nothing like the general row which there would have been in Birmingham under similar circumstances. There is not the slightest doubt that in all what we call general moral condition, and in general level of civilisation, men of the lower classes are greatly ahead of those in the old country.

But there is one thing which is very striking in comparing Australia with the United States, and that is the absence of inventiveness. There is hardly such a thing as an original Australian design for any mechanical or labour-saving apparatus, in spite of the absence of workmen or servants; everything is either of English or American patterns.

It is difficult at first to realise what a scarcity of labour means in the comforts of life. It will scarcely be credited that people eat tinned butter on stations where there are thousands of cattle running about. There is either no one to make the butter, or no one will take the trouble to do so. At some of the country railway stations there is neither station-master nor porter always at hand. If you want the train to stop, you hold out a red flag that you find lying ready for the purpose, and then pay your fare to

the guard. The lowest class porter in New South Wales gets seven shillings and sixpence a day, so the Government has to be economical of such valuable men.

Sydney Harbour is a sheet of water of which any country might be proud. The entrance from the sea is only about half a mile across, and bounded by a precipitous bluff on either side. These are the Port Jackson heads of the charts; and on the southern cliff stands one of the most powerful lighthouses in the world. Inside, the harbour radiates into innumerable creeks, like small lochs on the Clyde. The city of Sydney clusters round three or four of these inlets at the western extremity of the harbour, and the water is so deep close inshore that the largest steamers lie along the wharves right at the bottom of the main street. This is what gives Sydney the advantage over its rivals, for Adelaide and Melbourne are both five or six miles from their respective ports.

But though the indented line of the harbour is very pretty, the shores are surrounded by low sloping hills, more or less covered with the uninteresting gum-tree scrub, and the villa architecture is rarely pretty. Still, Sydney may rank amongst the finest harbours in the world, though we do not think that it is so picturesque as Rio Janeiro; but we will defer a more detailed comparison till we reach that city in the course of our travels.

One curious feature in the landscape is the palisade in the water which runs round the bathing shed that is attached to almost every house on the shore.

This is as a protection against sharks, which swarm in the harbour. The number of large jelly-fish which float in the water is also very noticeable.

The climate of Sydney is not considered so good as that of Melbourne. A north-easterly sea breeze comes in every day in summer about ten o'clock in the morning, and this is considered damp and relaxing by the residènts. In fact, they say that Sydney is a limper place than Melbourne, and this is probably correct. The finest climate in the Australian colonies is undoubtedly Tasmania, for there you escape the parching hot winds during the summer months in the other colonies. New Zealand is even better, and presents a far greater variety of scenery and climate than Tasmania.

We left Sydney on the 10th April 1885 for a five days' run to Noumea in New Caledonia, where the steamer calls on her way to Fiji. The first two days we experienced variable weather, with but little wind from north-west or north-east. During a squall on the latter day there was the curious phase of the north-west wind shifting to north-east during a squall and then coming back again to the north-west when all was over. The next day, when still some 300 miles from the Tropics, we picked up an easterly trade wind, and the typical trade cumulus. This was of course the regular south-east trade, here deflected to the east, and the fourth day the wind blew quite strong with hot showers. The increasing warmth and the numerous flying fish, also showed unmistakably that we had got into a new climate.

Noumea Harbour was sighted soon after daybreak, just in time to note one of the most characteristic features of land and sea breezes. We had been running in a moderate south-east breeze, but at that hour the wind seemed to die out as it approached the land, and the whole island was surrounded by a belt of dead calm four or five miles across. The outside breeze seemed gradually to eat into, and encroach on this calm, till by about 10 A.M. it blew home on shore, as the sea breeze. The observation has long been known, that the sea breeze comes in from a certain distance out at sea, instead of beginning inshore and working outwards as might have been expected. The reason cannot be explained, for the exact theory of land and sea breezes has not yet been discovered by meteorologists. Of course there is no doubt that they are due to the unequal heating of land and water, but the precise *modus operandi* is uncertain.

New Caledonia is an irregular-shaped island some 200 miles long and only about 30 wide, with a range of high hills running down the whole length. It is evidently the top of a submerged mountain chain, which now only shows the former summits lifted above the level of the sea. The whole is surrounded by a barrier reef of coral at an average distance of one to three miles from the shore; but here and there, are gaps in the limestone barrier which permit ships to enter. These openings in the coral are usually opposite places where fresh water streams run down into the sea from the mountains; for the fresh water kills the

coral insect, and so the barrier is not broken, but simply not formed at those points.

The steamer entered by one of these openings in the reef, and was soon alongside the pier of Noumea. The pilot boat which boarded us was rowed by a crew of Solomon Islanders, who were of a type of man quite different from any we had seen before. They were great big dark-skinned powerful-looking men, whose hair grew in tufts like a mop. One man had red hair, which looked very strange at first, but this was the effect of the lime with which they dress their hair to kill the vermin. It can easily be understood that in such a climate, and with hair perhaps more than six inches long, standing straight out like the head of a mop, that some such precaution would be very necessary. We afterwards saw several men with their heads quite white with the lime they had plastered on their hair. After being on for a day, the head is carefully washed and oiled, and should then keep in good condition for some time.

The natives of New Caledonia itself appeared to combine some of the features of the Australians with those of the moppy woolly-haired Papuans, such as the Solomon Islanders. Up country both men and women go about almost naked, but in the towns they have to wear clothes, though they still adopt the old custom of binding their hair with scarlet hybiscus or other flowers.

Soon after our arrival we went ashore to walk round the straggling muddy town, and then took a drive into the country. The scenery is pretty, and

though there were a few mangroves on the beach, the general character of the vegetation was rather semi-tropical than truly tropical. In fact the forest seemed to be somewhat transitional between the vegetation of Australia and the jungle of Fiji which we saw later on. There was a kind of gum-tree, and also of iron wood, with other things which reminded us of Australia, mixed up with a luxuriant undergrowth, but still not the profusion of creepers and parasites which are characteristic of truly tropical vegetation. It is noteworthy that both the people and the plants seem to be somewhat transitional in their character between the Australian and Papuan types of man and nature. We had tea in a small country house in Ance Vala Bay. Mangos, guavas, custard apples, bananas, and other tropical fruits grew in profusion, and it would have been most delightful but for the mosquitos. Every morsel of skin was attacked, and they even bit through gloves and stockings. I counted forty-nine bites on one hand, and next day my hands and neck were so swollen that I did not care to go for another trip up into the mountains.

It would be interesting to know the origin and development of the mosquito. It is only the female that bites, and she is equipped with a very elaborate apparatus for piercing and sucking. But then it is so hard to understand how few of the millions that are born ever get a chance of tasting blood in the course of their short existence. These pests live mostly in jungles, where there are few hot-blooded animals to suck, and die out before building and civilisation where men

and animals abound. It is just the same with the leeches which swarm in tropical jungles. All leeches suck, but the percentage of those that ever enjoy a meal of hot red blood must be infinitesimal.

The harbour of Noumea is magnificent, for it is completely landlocked from every wind, with deep water close inshore. There is a large island, just in front of the town, where great convict barracks have been erected; and the men come over every day to work at the arsenal in the town, or on the roads in the country. The convicts are the *raison d'être* of Noumea, for the French have turned the whole island into a penal settlement, not only for men undergoing an actual sentence of imprisonment, but for the so-called *liberés*. These last are convicts who have served their time, but who are compelled by the terms of their sentence to remain for the rest of their lives in New Caledonia. They are a great embarrassment to the Government, for the Australian colonies won't have them on any terms, and the *liberés* themselves do not take kindly to any kind of labour. The Government have recently tried a very curious social experiment to remedy this state of affairs.

The male convicts serve their sentence at Noumea; the females at Bourrail, some one hundred miles up the coast. When their respective terms are finished, the women are boarded in a sort of convent at Bourrail, and the men are encouraged to take their choice of such as may be available, and to marry them, by the offer of free grants of land and of other advantages. The results so far have not been encouraging. The

men will not work when they have got the women, but hang about the town and pick a precarious livelihood as best they can; and the state of morals in the streets of Bourrail is said to be terrible. It is difficult to conceive anything less likely to turn out well than the union of a French convict with a French woman of the same type as himself, after a long imprisonment in a tropical climate, and after both have been brutalised by companionship with the worst of their kind. Health, energy, morale, are all gone; but fortunately such marriages are rarely fruitful, and the extinction of the breed is the best thing that can happen. These *misérables* are past mending; the cure must be sought in a social or political system which does not bring such a kind into existence.

One night we went to hear the convict band play on the *Place*. About thirty performers were playing extremely well, but what shall I say about the looks of the men. There was not a good face among them; most had very bad physiognomies, many were scowling, and every man had a round back. Even when they were playing, there were only two among the whole lot who stood straight up, the rest were either lounging or supporting themselves against the balustrade of the band-stand. This apparent feebleness was not the limpness of exhaustion, but the want of pluck and morale and self-respect, which by themselves would straighten the back, and make an upright man in both the literal and metaphorical sense of the word. The conductor had been the leader of a celebrated band in Paris, but was under a long sentence for

forgery; his face was dead, and he wielded his baton without life or energy, so unlike the go or *élan* of a French musical leader. Altogether it was a sad and pitiable sight, but is it not a curious commentary on the old and new civilisation, that the best band south of the Equator is found among the outcasts of France, and not among the free men of Australia? The social and political life of Australia could produce neither the criminals nor the *artistes* of New Caledonia.

The rainy season in New Caledonia was drawing to a close at the time of our visit; and though we experienced no very heavy rain, still there were constant showers, and a great deal of irregular cumulus about. During one of these showers I noticed in a marked degree, what I have so often seen in the Tropics, that the diameter of the coloured fringe of the rainbow appears to be much broader than in England. This is probably connected in some way with the size of the rain-drops on which the light falls, for the appearance is most obvious in the portion of the bow nearest the ground.

There was a ship lying in the harbour of Noumea which had had all her sails blown away in a hurricane a little to the north of the island. We were now almost in the same latitude as Mauritius, and the hurricanes here are of the same type as those in the South Indian Ocean, but seem to be rather less severe. Here, as there, hurricanes originate in the belt of low pressure which lies between the south-east trade and the north-west monsoon, but it is almost certain that the popular idea that these storms are caused by the meeting of

these two opposing winds is not correct. At this season the south-east trade was beginning gradually to replace the irregular northerly winds which represent the regular north-west monsoon nearer the Equator, and for this reason the winds during our stay were very variable. There was, however, a very regular land and sea breeze; but the relation of the surface winds to the upper clouds was not by any means constant. We noticed, however, what we saw afterwards to be almost universal in the Tropics, that the conflict between the land and sea breeze was almost always accompanied by showers of rain. Here the showers were very ill defined, and the cumulus cloud never assumed bold forms, but in many other places which we subsequently visited there is a sharp thunderstorm at the daily turn of the wind.

The climate of New Caledonia was unpleasant on account of the close greenhouse-like heat of the air, and of the innumerable mosquitos; but the island is said on the whole to be healthy, as fever and dysentery —the scourges of the Western Pacific—are rare.

We left Noumea soon after noon on the 17th April *en route* for Fiji. The ship ran for three hours inside the barrier reef, and then passing through a gap in the coral, plunged out into the rolling swell of the open Pacific. The vessel stood on an east-north-east course for three days, with light winds from north-east to south-east and variable weather; sometimes the sky was almost all blue, but at other times the clouds gathered irregularly into cumulus or strato-cumulus, with occasional slight showers of the

true trade wind type. The weather grew very misty as we approached the land, and heavy cumulus was resting over the mountains as the ship ran into the harbour of Suva in the island of Viti Levu or Great Fiji.

CHAPTER V

IN FIJI: A STRANGE CRAFT

The natives of Fiji have suffered so much from measles, and other imported diseases, that the quarantine regulations of the port of Suva are very strict. There was, therefore, some delay in our landing, but this gave time to look about and survey the novel scene. The centre of the island is mountainous and clothed with a thick mantle of vegetation; a barrier reef of coral surrounds the island at a distance varying from one to three miles from the shore; and the harbour of Suva is formed by a point of land, jutting out so as to form an arm, which shelters the bay from the prevailing south-east wind.

The crew of the health officer's boat were typical Fijians—big powerful-looking men of brown colour, with long moppy hair all turned yellow by the use of lime or ashes. They were dressed in what is now the universal costume of the islanders—a waistcloth, reaching down to the knee, commonly known as a *sooloo*. In the old days the cloth was replaced by a fringe of fibre, and was then called a *liku*. Compared with the men in New Caledonia, these Fijians were

MAP OF GREAT FIJI AND SURROUNDING ISLANDS.

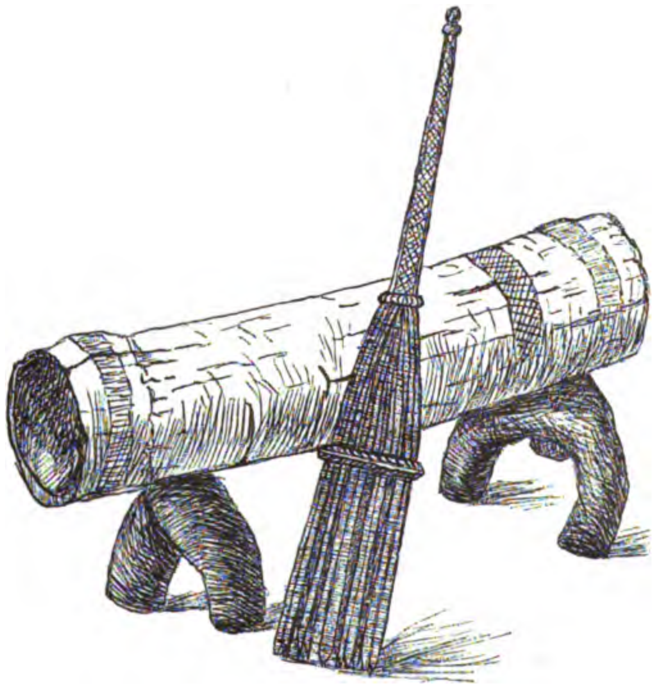
Stanford's Geog^l Estab^t London

certainly larger and lighter coloured, while the hair was longer and perhaps scarcely so woolly.

The chief part of the town itself is built along the shore, but isolated bungalows dot the hill, and the pleasantest situation for a house is the top of the ridge, where you see the sea on both sides and always feel the trade wind. Suva lies on the wrong side of the hill to catch the wind, and for that reason is very hot and oppressive. Most of the houses face the north-west, and therefore get the full glare of the afternoon sun without a whiff of the sea breeze to mitigate the heat. The thermometer often registered from 92° to 94° in the verandah of the hotel; and that temperature, with the steamy damp air of the Tropics, is very trying. There are very few trees left along the beach, but here and there a stray *pandanus*, with its curious aerial roots, sufficiently indicates the tropical climate of the island.

We were soon introduced to some of the peculiarities of native life as we strolled along the shore. The men bring canoe-loads of fruit, cocoa-nuts, etc., from the neighbouring villages, and camp on the beach till the cargo is sold. They simply make a lean-to of leaves with the lee-side open, so as to be sheltered from the wind; then they spread a few mats on the ground, and cook their meals by a little fire on the beach. A party was boiling some bread fruit, so we tried a little bit, and found it was soft and not unlike a tasteless potato both in substance and flavour. But the most characteristic feature of a Fijian sleeping-place is the pillow. The men are very proud of their

fine mops of hair, and the longer the mop the more vain the owner is of his appearance. If he was to lie down in the ordinary manner the hair would be spoilt, and stand out unevenly during the day. So before going to bed he gathers his hair carefully upwards,



FIJI COMB AND PILLOW.

and wraps it round with a strip of *masei*—the bark of a tree used by the natives as cloth,—and then rests his neck on a bit of bamboo raised about five inches from the ground by means of two little legs at either end. By this means his hair never touches the ground, and in the morning the curl-papers are unwound and the wearer's beauty is unimpaired!

The sketch is from a specimen belonging to the author, but is one of a very common sort. When a Fijian is travelling he always carries his own pillow about with him as a matter of cleanliness, and some of the chiefs have more elaborate arrangements. Europeans find these pillows very uncomfortable, and I never tried to rest on one without getting a crick in the neck. The mop-like hair is a most distinctive mark of the Papuan race, and so is also the still more curious fact that the men have finer mops than the women. This latter feature is supposed to ally the Papuans rather nearer to the higher animals in this respect than any other race. All through nature the male has the finest plumes. The lion has a finer mane than the lioness, the fox has a finer brush than the vixen; and in the home of the Papuans, the very *raison d'être* of the magnificent feathers of the bird of paradise is to make him attractive to his dowdy-looking mate. Only among the higher races of mankind do women have finer hair than the men; so that when we find the contrary among the Papuans, they may be considered as slightly nearer animals than ourselves. Savages, as a rule, abhor hair, and frequently pluck it out all over their bodies to avoid the distressing irritation of vermin. It can well be understood that a Fijian's head is a source of much care and trouble to himself. He dresses his head from time to time with lime; and as an ordinary comb would not reach down to the roots of his six or eight inches of hair, he employs the peculiar-shaped comb figured above to keep his head tidy. But in spite of all

his precautions, vermin will find its way on to his head. You often see natives hunting each other's mop, and then a curious custom prevails. Though the Fijian, unlike the Australian, is usually a pretty clean feeder, still he eats the game that is found in his own preserve. He would eat no other, but talking of the vermin says, "He eat me, I eat him."

The acting Governor—Dr. Macgregor—invited us to a picnic at the head waters of the new Suva waterworks on the Tamavua River the day after our arrival; and this trip gave a peep of the scenery away from the influence of the sea. We started in boats, rowed about a mile across the harbour till we came to the mouth of the Tamavua River (see map), and then pulled for two miles up the narrow stream. At first the banks were fringed with mangroves on either side, but occasionally a small opening in the vegetation revealed a tiny plantation of bananas, or the clearing round a few native huts. Higher up, the feathery leaf of the bamboo mixed with the flat leaf of the tangle-rooted mangrove, and the graceful bright green fronds of the tree-ferns contrasted with the dark featureless foliage of the prevailing jungle trees.

At last the boats arrived at a place where the pipes of the waterworks crossed the stream. Here the party disembarked, and found a track about three or four feet wide cut through the jungle up a small valley. We walked along this for about two miles, through tropical scenery of the most luxuriant description. On the dark sides of the ravine trees of various kinds—tree-ferns, screw-pines, etc.—all

fought with one another in a race towards the light of the sky, while their thin drawn-out stems were almost lost in an undergrowth of numberless plants and ferns. Every branch and every stem was covered with epiphytic creepers, ferns and mosses also struggling with one another, and so interlaced that the general impression left on the eye was that of a confused mass of tangled green, which could not be unravelled into its constituent elements. But if one had had time to disentangle this mass, the results would have been most interesting.

We were shown, among other curious creepers, the wire fern, whose stem exactly resembles, both in size and shape and colour, an ordinary piece of wire about the thickness of a pencil, and which literally ties the trees together. One can only see that it is a fern by little bunches of fronds which spring out of the stem at longish intervals. Another beautiful fern grew as an epiphyte on the stems of big trees, and was very strange, for it seemed to make a sort of bracket for itself, wrapped as neatly round by one of the leaves as if the whole had been grafted on by a hand.

This was altogether the most striking and beautiful bit of jungle I have ever seen, and the beauty was a great deal owing to the profusion of ferns with their bright green foliage. The jungles of India and of Borneo are much darker and more monotonous than those south of the Equator, and this is partly owing to the comparative absence of ferns in the former countries.

The predominance of fern life in one part of the

world rather than in another, belongs to the far distant geological history of the earth; but here the profusion of vegetation generally is chiefly the result of the abundant rainfall and of a hot sun. Something like 120 inches of rain falls during the year, and there is no real dry season. We were now at the end of the wet season, but it rained more or less nearly every day; and while picnicking we constantly heard thunder growling in the hills, or were sprinkled by slight showers of rain. In the ravine, and away from the sea breeze, there was not a breath of air moving. The soil was a wet, sticky, greasy clay that it was hard to walk over, and the air was steaming and reeking with moisture like a freshly-watered greenhouse. No wonder, then, that plant life was abundantly developed here; but on the other side of the island—which is the lee-side to the prevailing trade wind—there is so much less rain that the natives can burn the trees, and a great deal of the country is therefore covered with long grass. There was very little sign of animal life in this jungle; all that could be heard was the note of a large pigeon which barked like a dog, and the chirping of the tree crickets. The vegetation was really so rank and vigorous that nothing else could live.

We stopped for lunch at the head of the waterworks, about 300 feet above the sea, where a number of convicts were at work, laying down pipes, digging trenches, etc.; some were Fijians, some Indian coolies, and two dreadful-looking beings were white men. The natives were mostly there as a punish-

ment for adultery; and though penal servitude may seem to our laxer notions a very severe sentence for such a crime, a Fijian would think otherwise. In the old days, club law settled such cases speedily and for ever, where now a tardy legal process may lead to a lifelong punishment. The two whites were painful spectacles of the pitch to which men may become degraded; one was there for murder, the other for a very dreadful crime.

After lunch we turned our way homewards, but while crossing the bay got caught in a thunderstorm, and this slight specimen of tropical rain was quite enough to wet us to the skin.

On the following day Mr. German and myself started with the Hon. James Murray to spend a few days with him on his sugar plantation on the Navua River, and were thus enabled to see the planter's phase of Fijian life. We started in a steam launch, and ran for about five hours inside the reef till the mouth of the Navua River was reached. Cruising among coral islands is unlike sailing anywhere else. Instead of launching a boat into surf, you start and sail along through smooth water, though on the seaward side there is always a line of foaming breakers, where the heavy swell of the Pacific meets the barrier reef. Inside, the water is so shallow that you can easily see the bottom, and the white coral, and the fishes, and the great black slugs, eight or ten inches long, that look like enormous snails. These ugly-looking creatures are, however, a valuable article of commerce, for they are the *bêche*

de mer or *trepang* so much prized by Chinese epicures.

There is such a bad entrance to the Navua River that we landed a short distance from the mouth, and walked over some fields till we came to the main river. This we crossed in a canoe, and then a walk of about two and a half miles through cane fields brought us to Mr. Murray's bungalow, on the Tanaroa estate, marked "T" on the map of Fiji. Here we found ourselves on a small isolated hillock rising out of the flat delta of the Navua, surrounded by fields of bright green sugar canes. On one side you looked over the sea, with the foaming reef and the small island of Mbenga in the distance, while on the other side the mountains of the interior rose above the village of Namosi. Overhead and all round floated the ill-defined broken clouds that are so characteristic of Fiji, and which are due to the arrest of the damp south-east trade by the wooded mountains.

The next morning we started to look round the plantation. Mr. Murray had about seven hundred acres under cultivation, and employed about six hundred hands. These were all Indian coolies, imported at great expense from Calcutta; and the employer is under stringent government regulations as to pay, length of service, and medical attendance, while every death has to be reported to the proper department at headquarters.

A neighbouring plantation employed nothing but Polynesian labour, and it was curious to see the

difference between the various races. Men from any island in the Pacific are included under the general term of Polynesian, and a good deal of experience is necessary to tell one race from another by sight. The broad features of some of the tribes are, however, very obvious. The smallest and blackest men are from New Ireland. They are of quite a different tint of black from the African negro, and are of very poor physique. The hair is short and woolly, and the general appearance low and miserable. Then the Solomon boys are not quite so dark, but bigger and more savage-looking, with moppy heads; and between these types there are men from Ambrym, New Britain, and others of the Melanesian islands.

The so-called Line islanders are of quite a different kind. The Line islands do not appear in geography books, but that is the term used all over the Pacific to denote the groups of small islands which lie near the Equator, and that appear on the charts as the Gilbert and Tokelau islands. These are very small low coral *atolls*, little better than sandheaps, which only rise a few feet above the sea. Only cocoa-nut palms grow on them, and the water is so brackish that the natives have nothing to drink but the milk of the cocoa-nut, and nothing to eat but the inside of the same nuts. The inhabitants have a slightly Japanese cast of countenance, and are much lighter in colour than the races just mentioned; but their physique is even worse than that of the New Irelanders, and they are not now considered worth importing. Most of the Polynesians have their skins more or less

scarred, either with tribal marks, or from skin diseases, but the Line islanders have a very curious marking, as if they had tried to tattoo a coiled snake on the body. This coil-like mark is, however, not artificial, but is the result of a parasitic disease known as "Tokelau ringworm." There were very few Fijians working, for the existing government regulations make it almost impossible to employ them on contract.

Opinions are very much divided among planters as to the relative merits of the various nationalities, and a good deal depends on the planter's knowledge of the different races. Some who understand the ways and thoughts of the Pacific find Polynesians better workmen than the Indian coolies, while others who know the coolies, get on much better with them than with Polynesians. But there is one very striking fact, that the amount of work done is not always proportionate to the apparent strength of the man, so far as the eye can judge. An Indian coolie, whose spindly shanks could be encircled by the finger and thumb, will do more work than a stalwart muscular-looking Fijian. Perhaps something may be due to lack of will, but still the Fijian's muscles are very soft and comparatively useless. Anyhow, whatever race is employed, it is absolutely essential to feed the labourers on the diet to which they are accustomed. The coolie would not thrive on the yams of the Pacific even if he would eat them at all, and the Polynesian would reject the rice of the Hindoo. Every coolie ship has to bring a certain amount of rice and curry

stuffs for the Indians, and the Polynesians must be supplied with yams and bananas. All change of diet is a strain on the constitution, and if other circumstances are unfavourable, death may ensue from general disturbance of health. Europeans suffer as much as savages from this cause, and nothing is more conducive to health in the Tropics than a plentiful supply of imported food and fruit.

We went one morning to the coolie hospital, and found there about fifty men and women under treatment for various complaints. No less than twenty-seven were in for what are called Fiji sores. These are malignant ulcers that will not close, and which attack Europeans quite as much as the natives or imported labourers. Very little will set one going. A scratched mosquito bite, or an accidental abrasion of the skin, and white men can often never heal the ulcers without a change to the bracing climate of New Zealand.

Another peculiar disease is called "Thika." This is a kind of eruptive inflammation of the inside of the eyelid that causes great pain, but is not so dangerous to the sight as ophthalmia. But the most dangerous and deadly malady of Fiji is dysentery, which caused great mortality amongst the early settlers, and even now is much dreaded. Strange to say, there is no deadly fever in the islands, though a low slow debilitating fever sometimes occurs. On the whole Fiji has a sickly, but not a dangerous climate, if proper care is taken as to food and water, though under all circumstances it has a very

debilitating and relaxing influence on the constitution. All tropical climates induce languor, and in Fiji the hot damp air develops this lassitude to a very marked degree. We were shown a hut where an Englishman, who had come out to make his fortune, lay on his mat for five years doing nothing but reading novels, simply from the enervat on induced by the climate, without any definite illness. This particular state of mind or health is popularly known as "mat fever."

It is perhaps from the lowering effect of the climate on the nervous system that tetanus or lock-jaw is so often the sequel of quite a moderate wound or accident. The prick of an arrow, the wound of a spear, or even the contusion of a bad fall will too frequently end in the terrible death from lock-jaw, and the poisonous properties that have been ascribed to native spears and arrows are probably only due to the influence of climate in developing convulsions after slight injuries. Wounds that would scarcely be noticed at home will here involve death, and the secondary effects are out of all keeping with the primary cause.

It is more difficult to explain the prevalence of the unsightly swelling of the limbs, known as elephantiasis, in an aggravated form. It is very common to see both men and women whose legs or arms have grown into great cylinders of flesh, and sometimes the disease takes the form of an external growth like a tumour. The size to which these abnormal growths reach is hardly credible, but one authentic case is on record in which the

weight of the man after the growth had been removed by cutting, was less than half the weight of the same individual before the operation. This means that the weight cut off was more than the weight which was left of the man, but nevertheless the patient recovered completely. The disease seems to be simply a sort of hypertrophic or excessive growth of the skin, with comparatively little derangement of the limbs or organs underneath, but what sets the growth up, and why the disease should attack some parts of the body in preference to others, has not yet been discovered. Anyhow the ailment is very common, for it is hardly possible to look at any body of natives without seeing one or more who show symptoms of this elephantiasis, and even some of the old beach-combers occasionally suffer from the same malady.

We started one afternoon to visit an estate in the mountains, and after walking about a couple of miles across cane fields, came to an old beach-comber's house on the banks of the Navua River. These beach-combers are an institution in the Pacific, and this particular specimen was popularly known as "Harry the Jew." He, like many others of the same sort, was originally a sailor, who was either wrecked or had deserted his ship here, and had adopted the habits and customs of the natives, and married various Fiji wives. He is now a shrivelled old man, much bent with age, but his half-caste children are a fine race physically. When we saw one of his daughters, dressed only in the short waistcloth of the country, poling her canoe up the river, we all thought her one of the

finest shaped women we had ever seen. There is another man of the same class—now an overseer in a neighbouring plantation—who is known as "Cannibal Jack." The natives say that he used to assist at their cannibal feasts, and though he denies the fact there is very little doubt that the report is correct, for savages would hardly invent such a story. We arranged with "Harry the Jew" for a canoe and two men to take us up to our destination and bring us back the next day. This was our first introduction to a river canoe, and certainly it was unlike any other craft one had ever been on. The main body of the canoe was dug out of the trunk of a tree, about eight or ten feet long, and only sixteen inches across. Five or six sticks were lashed across this, so as to project perhaps three or four feet, and to their ends a long oval block of wood was attached, which floated half immersed in the water, and kept the boat from capsizing by the resistance that it offered to being either more submerged or more lifted out of the water. When our two selves, our two pole-men, and a little baggage were all on board, there was just one inch of free board between the top of our gunwale and the surface of the water, and if it had not been for the outrigger it would have been impossible to stir an inch. However, the river was very smooth and the boat got on pretty well, but wherever there was the smallest rapid either the natives or ourselves had to get out. In narrow places or shallows the outrigger used to catch, and altogether a canoe of this class cannot compare with the birch canoe of Canada either for

carrying weight or for traversing rough water. The form of canoe is doubtless dictated by the materials that would be available for men who were, till recently, in the stone age of civilisation. When only stone axes and fire are available for hewing wood, there is no way of making planks, and even then, without nails, it is difficult to put planks together tight enough to keep out water. There is no tree in the Fiji jungle whose bark is available as a substitute for birch, and considering the materials at their disposal, the natives have certainly showed great ingenuity in devising the out-rigged canoe.

The men poled for about three miles up the river and then stopped for a short time at the village of Naquab. This was an agglomeration of twenty or thirty huts, or rather houses built somewhat irregularly on a bend in the river, and surrounded by plantations of bananas. We went into a great house in which, according to the custom of Fiji, the unmarried men and strangers sleep. This was a long dark room with a sort of passage down the centre, on either side of which the floor was portioned off into sort of stalls by barriers about six inches high. Each stall was a man's portion, and was large enough for him to lie down comfortably in, while one or two seemed to have small cooking fires in their own space. This separation of the sexes was a characteristic feature of Fijian life, and in some parts I believe that even the married men inhabited these common houses and not the house of their families. On this occasion the chief was certainly in the big house, and after

talking to him through the medium of a friend, we proceeded on our journey.

The Navua debouches at Naquab from the mountains on to the flat fertile delta, and the scenery got very pretty higher up the river. After poling for about two miles the canoe stopped by a landing at the side of the water, and leaving her there we climbed for a quarter of a mile up the steep bank of the river to a clearing in the jungle, which was the coffee plantation of "El Dorado,"—marked "E" on the map,—where we were going to spend the night. This enterprise unfortunately belied its name, for it had turned out unlucky for the owner. It was sad to see the clearing that had been cut out of the primeval jungle at the cost of much labour and expense rapidly reverting to its former condition. The brick-red earth, so carefully planted with the small green orange-red berried shrub that yields the coffee of commerce, was now all overgrown with grass and creepers, and presented a most distressing spectacle. Nor were the surroundings more cheerful. The little island of open ground in the midst of the tangled forest, only served to emphasise the darkness of the surrounding jungle, and to show the dull gloomy sky in which the rain and mist and cloud could scarcely be distinguished from each other. The earth and rooms were reeking with moisture, and the hot steamy air felt like the inside of an orchid house. The clothes that we hung up to dry at night, were as wet in the morning as when first put out, and our boots and belts were covered with mildew in a few hours. The mosquitos

were, if possible, worse here than in the open delta of the river, and if it had not been for a mosquito-proof room—*i.e.* a room with gauze doors and windows—living would have been most uncomfortable. Altogether it was one of the most depressing places I have ever visited, in spite of the hospitality of the owner.

We returned to Mr. Murray's bungalow the next day, and saw a curious sight while passing down the river in our canoe. A native was going into the river to fish, and had replaced his cotton *sooloo* with a wreath of banana leaves. This was natural enough, but to protect his face and eyes from the glare of the sun on the water he had blackened his already dark face. We saw the same thing several times afterwards in Fiji, of men and women blackening their faces, especially when going to fish on the reefs, which are more exposed to the sun than a river. Some account will be given in the chapter (p. 289) on the Himalayas, of men blackening their eyes to protect them from the blinding glare of fresh fallen snow.

The next two days we were almost entirely confined to the house by constant rain, which was very good for the sugar canes, but very disagreeable for travellers. Sugar cane requires at least eighty inches of rain, pretty evenly distributed throughout the year; here the average rainfall is about 120 inches per annum, and falls more or less in every month. Precipitation varies enormously in different parts of the group; it is greatest, of course, on the windward side of the mountains of Viti Levu and Taviuni; least on the lee-side of the hills, and on the small islets that

hardly rise above the level of the sea. The greater portion of the rain falls during the night, except in November, when heavy thunderstorms form about 4 P.M. This predominance of night over day rainfall is shared by many places in the Tropics, but the reason cannot be given satisfactorily in our present state of knowledge. We were now in the end of the rainy season, which lasts from about November to May, and both here and at Suva were on the windward side of the island, and in the full sweep of the south-east trade. The influence of high land in the development of cloud and rain can be seen at a glance as you approach Fiji from the sea. Away from land there is little cloud, and that of the small detached cumulus type, but the moderate-sized islands have each their own crown of cumulus above the highest points, while the mountains of the greater islands are totally enveloped in cloud and rain.

The general features of the weather during our stay in Fiji were tolerably uniform—viz. a cloudy sky with broken and irregular cumulus, constant showers, and ill-defined thunderstorms, sometimes passing over the sea, sometimes grumbling in the mountains. But the ill-defined character of everything was remarkable, for the showers and thunderstorms did not come and go with a strongly-marked sequence. A heavy cloud might send down a few drops of rain, or, during a rainy time, the downpour might be tremendous for a few minutes. It was not like a sudden storm appearing in a bright sky, and leaving the heavens clear again after a certain time; but sunshine

and rain and cloud alternated without any sudden change from one to the other. The winds too were irregular and ill-defined; but in a general way there was a land breeze during the night, and the south-east trade, as a sea breeze, during the day. The highest clouds were almost always from the north-west at all hours, but Suva was so unfavourably situated for wind observations that I could not work out all the details as carefully as I should have liked. I was told, however, that the tide has a decided influence on the wind in Suva Harbour; and though a similar effect can be observed in any British tidal river, still it was interesting to find the same thing in the Tropics.

On our way back from the Navua to Suva, we had an opportunity of sailing in a sea-going Fijian boat. She was like the river canoe before described on a much larger scale, only fitted with a mast and mat sail. The hull was a remarkable piece of work, for a sort of top-side had been added to the original dug-out trunk to heighten the sides about eight inches. These planks were simply tied on to the lower body of the boat by bits of twisted cocoa-nut fibre, called sinnet, but the workmanship was so good that very little water leaked through the junction of the two pieces of wood. The outrigger was large and heavy, and a small lean-to, where the fishermen lived and cooked their food, was erected on the platform between the main log and the outrigger. The mast works fore and aft to a certain extent on a hinge, and leans towards the bow for the time being; while the mat

sail is shaped like an isosceles triangle. The pointed end of the acutest angle of the triangle—which forms the tack of the sail—is fixed to the deck where the bow would be for the time being. We shall see presently that the bow and stern are interchangeable. The uppermost of the long sides of the sail is supported by the top of the mast, while the lower side of the triangle serves as a sort of boom, and is held in its

A FIJIAN SHIP.

place by a sheet. Steering is done by an oar, but as the outrigger must always be on the windward side of the boat, she cannot be put about like a cutter or even as a lugger. To go about, the helm is put up instead of down, so as to bring the wind aft. The tack of the sail is then brought to the opposite end of the boat to what it was on before, the mast swinging on its hinge to suit, and the steering oar also changes places from one end to the other, so that what was the bow of the ship at first is now the stern. The boat is now head to wind, and can be paid off on to the opposite tack

to that she was on, with the outrigger on the windward side.

All this will be more intelligible by glancing at the illustration, which is adapted from Williams's *Fiji and the Fijians.* The *thama,* or outrigger, is on the left of the picture, and the spars which lash it to the main body of the boat can be seen crossing the opening in the deck at the extreme left. The platform between the two portions of the ship, and the lean-to which is built on it, are also very obvious. The bow is facing the reader, and the mast slopes that way; while the positions of the two sides of the sail, one at the masthead, the other hanging down like a boom, sufficiently explain themselves. The two jagged lines running along the sides of both the main boat and the *thama* denote the lashings which keep the upper top-sides to the lower portion of each section of the craft.

We went for a sail in this boat, and I took the helm for a few minutes to see how she steered. It seemed extremely awkward, for the oar was very heavy and difficult to move from side to side. Two or three natives are often required to keep a big canoe on her course, and they are sometimes injured by blows from the end of the oar when a heavy sea strikes the blade. Such is the Fijian ship, and one sees at once that while she is a combination of great ingenuity, and of necessity from the materials or implements that were available, she has some very great defects. The outrigger, or *thama,* is indispensable when the beam of the boat is practically determined by the

diameter of a single log. Everything else turns round the peculiarities of this *thama*. If the outrigger is totally immersed the boat capsizes, so that the *thama* must always be to windward. This is why she cannot tack; she must bring the wind aft, and lose a lot of way to windward; you cannot shoot her up into the wind like a smart cutter, and be about on the other tack before she has lost all her way. But the boat also goes over if the *thama* is entirely lifted out of the water, so that the sheet must always be carefully watched, and let go at every heavy gust. There is no reaching with the lee-rail under water in a Fijian canoe. The *thama* itself is also a source of danger, for the strain on the spars which attach it to the body of the boat is very great. This may perhaps be bearable in the smooth water inside the barrier reef, but outside, the heavy swell of the Pacific causes such a strain, that the spars or their lashings sometimes part and the canoe goes down. The accommodation is miserably poor, for there is only the small lean-to as a shelter from sun, rain, or spray, and the cargo is easily damaged by water.

Can one wonder, then, that the ambition of every Fijian chieftain is to own a smart cutter, or even a schooner which can make good weather in any sea, and go to windward in a way that their native craft could never do, in spite of the great skill with which native sailors navigate these strange craft?

CHAPTER VI

AMONG THE ISLANDS: THE MEETING OF THE CHIEFS

SHORTLY after our return to Suva the acting administrator, Dr. Macgregor, invited us to go with him for a tour round the islands in the neighbourhood of Kandavu, and to wind up with the *ve bose* or meeting of all the chiefs of Fiji. This meeting takes place once a year in some part of the group, and was to be held this time at a town called Tavuki on the north side of the large island of Kandavu.

We started on the 30th April in the Government steamer, the *Clyde*, and by daybreak next morning found ourselves off the Solo Rock on the northern edge of the great Astrolabe Reef. This is a projection of the reef which surrounds Kandavu and some small adjacent islands, and the object of our visit was to prospect the site for a lighthouse. The rock is only about thirty feet long by ten feet high, and is completely honeycombed by the action of the waves. The boatmen thought they saw something like the coils of a snake at the bottom of a hole, and soon dislodged three water-snakes eight or ten feet long. They were very thin for their length, and did

not seem at all inclined to attack us when we despatched them with a boathook, but made for the water as quickly as they could.

After Solo a small islet close by was visited which had been proposed as an alternative site, and then the administrator decided to go to a village on the island of Dravuni in the gig, and to send the steamer back to Suva. An old chief was waiting at Dravuni for an opportunity of returning to his own home on another island called Mbullia, so Dr. Macgregor said that he would take the man back in the gig, though it was a little out of our way. As the boat approached the shore of Mbullia, threading her way with much difficulty through the reef, we saw people running from the beach into the woods, and by the time we were off the landing-place for the town there was quite a crowd ready to receive us. The old man seemed very glad to get back to his people, and did all he could to welcome us in native fashion. What interested us most was an old war canoe, which could hold fifty men, drawn up on the beach. This was an unusual size, and formerly the building of such a boat was considered the achievement of a generation, and its creditable completion a cause of triumph. The main body could not be made out of the trunk of a single tree, but several pieces of wood had to be carefully scarfed together, and the top-sides had to be much deeper than usual. Even when completed, the launching of such a craft was a matter of great difficulty and anxiety. The largest ever made in Fiji was 118 feet long, and should have held over 100

men, but it was impossible to launch it, and it was called *Rusa i Vanua*—perished inland. At Mbau, in the old days, a new first-class war canoe was run down to the sea on rollers of living men, amidst great excitement and rejoicings; but such scenes have now passed away for ever.

After leaving Mbullia, the gig was pulled to the town of Yambia on the island of Ono, but did not arrive till after dark. We were received by the chief, who was a great man in the district, in a large house. This, like others in the district, was an oblong building, the flooring raised some feet above the ground on stones; but the sides constructed of wood, reeds, and leaves. The floor was covered by two or three thicknesses of the mats for which Fiji is so famous, and, curiously enough, the house was remarkably clean and free from vermin. The mats were softer than would have been expected, but there was nothing in the way of either chairs or stools; everything had to be done lying, crouching, or sitting cross-legged on the floor. This, at first, is very fatiguing, but one soon gets accustomed to the novel conditions.

The acting Governor, his suite of three officials, and ourselves, squatted at one end of the dimly-lighted room, the chief on the right of the Governor, while his attendants, our own boat's crew, and other natives sat facing us at the other end. After a time dinner, consisting of fowls,—that are far from common here,—of pig, of yams, and of taro, was carried in on banana leaves, and laid out in front of us. Taro is peculiar to the Pacific, and is the most palatable and

nutritious native food. It is a tuber, about the size of a turnip, only longer and not so round, which grows in wet places where there is running water. One often comes across taro beds when walking among the islands, where the natives have built small terraces on the hillside up the course of a stream, and the plant grows half submerged in water. It is cooked by boiling, and when cut across shows a purplish rather mottled surface. The consistency is about the same as a yam or a potato, but it is richer than either, and when fried in a civilised pan and spread with butter it is most excellent. The water that flows from a taro bed is peculiarly unwholesome, and should never be drunk under any circumstances. We had neither plates nor knives nor forks, but ate with our fingers or our clasp knives on banana leaves as plates. The chief's young daughters, nice comely girls dressed in the waistcloth of the country, fanned us to keep away the mosquitos. For drinkables there were a few bottles of beer that had been brought in the boat, and some infusion of lemon grass that the natives use as tea. The ordinary drinking water is not very safe before it has been boiled. When finished, the girls handed us cocoa-nut bowls full of water to wash our hands in, and as soon as this was done the viands were seized and eaten up fast by the natives.

This performance was soon over and then a large root of the *yaqona*—pron. *yangona*—the *piper methysticum* of botanists, was brought in with great ceremony and presented to the Governor. This he accepted graciously, and said that he would like to

drink a little presently. Then, with low chanting and much hand-clapping, a big bowl on three low legs was brought in and laid on the floor in the space between ourselves and the natives who faced us; on this occasion the *yaqona* was grated instead of being chewed as usual, and after being placed in the bowl was mixed with a certain number of cocoa-nut shells full of water and stirred about. The chief operator, who brewed the *yaqona*, sat cross-legged behind the bowl facing us, and now commenced the difficult part of the operation. The fragments of the grated root were floating about in the liquor, and these would be unpleasant to drink, so some means must be devised to partially clear the fluid. The strainer is composed of fine hibiscus fibres, which were spread over the surface of the infusion; on this they floated, and the man who managed the bowl then began his difficult operation. He managed his net of fibre so skilfully that he contrived to enfold almost the whole of the floating fragments of the root, and then with much elaborate twisting of the arms and hands wrung the hibiscus out as dry as possible and threw it aside. This operation was performed twice, and then the drink was ready. All this time the chanting had been going on amidst solemn silence, but now the singing ceased. A man brought up half a cocoa-nut shell to the big bowl, when the operator took some fresh hibiscus fibre, and using it like a sponge nearly half filled the cup. Then the bearer with much humility brought the nut up to the Governor, who took the cup with both hands, and lifting it up to his lips drank the whole

straight off with great deliberation, and finally span the nut out on to the mat to show that it was empty amidst the exclamations of approbation — *a matha,* — it is finished. After the Governor, each of us white men were served separately, then the chief, and after that the rest of the natives drank the fluid up promiscuously.

This *yaqona* drinking is almost a religious ceremony in Fiji. In the old days if a stranger was offered *yaqona,* his life was safe; but if after a short interview with a chief the drink was not offered, then the guest would probably be killed and eaten. To refuse to drink *yaqona* was an insult, like refusing to drink with a man in Europe. The fluid is called *kava* in Tonga and many of the Pacific islands, and is better known in Europe by that name. It is more usual to chew than to grate the *yaqona* root. In Tonga the operation is always done by the youngest and prettiest girls, but here invariably by men. No woman is allowed to touch *yaqona* in Fiji; it is *tambu*—forbidden. Each man gets his piece of root, which he chews while the others sing. At a given signal each places his contribution into the big bowl before described—they look like rather dry yellow rissoles—and the rest of the operation is the same as if grated root is used. I think the grated concoction is the better of the two, for there is always a sort of stickiness about the chewed infusion, in addition to the European prejudice against the whole idea of the thing. But when cleanly made *yaqona* is decidedly rather good, for the astringent aromatic taste is both grateful and stimulating. Many white men drink the fluid habitually instead of

alcohol with great advantage, and *yaqona* seems useful in combating the relaxing influence of the climate. The appearance, however, is not pleasing to the eye. The fluid is a dirty grayish-brown colour, a little like soap suds, but the smell is aromatic and not disagreeable. *Yaqona* when taken to excess produces stupefaction but not unconsciousness. The drinker loses control over his legs, and can neither walk nor stand, but the reason is never entirely lost as in alcoholic intoxication. He is like a man who is drunk, as we say, in his legs but not in his head. As a rule Fijians do not drink to excess, but when they do so they can be readily recognised by their red inflamed eyes and a peculiar characteristic scabby skin. Nervous power and vigour are entirely lost for the time, but return when the habit is relinquished. Curiously enough the inside of a brown cocoa-nut bowl which is habitually used for *yaqona* becomes coated with a beautiful bluish-gray enamel. When the cup of *yaqona* is presented it is absolutely necessary to take the bowl with both hands and to drink with great deliberation, and without a "heel tap." The cup, when finished, should be thrown on to the floor with a spinning motion to show that it is empty, and the drinker should blow away the moisture that may remain in his mouth, or spit a little as if to get rid of any shreds of the root that may have been left in the liquid, and then give the *vakacivo*, a kind of toast or wish. He might say now for instance "Your health," or "*cagi vinaka*," "A fair wind," while formerly he might have expressed a wish for "a long pig," that is, for a human body (to be

eaten). The audience then make the peculiar grunt of approval and exclaim "*a matha*"—it is finished. The singing or chanting which accompanies the brewing of the *yaqona* is a most important and curious part of the ceremony. Such songs are generally called *mekes*, and the peculiarity is that many are in such ancient language that the natives at present can scarcely understand them. Sometimes the *meke* tells a story of old times and of ancient heroes, while at other times it partakes of the nature of a boating or fishing song. In most cases gestures are used to help out the meaning of the words. The prettiest and most harmonious song that we heard was a Tongan *meke*. The men sang in parts and waved their hands in keeping with the tune or sense. The story was that they were leaving the shore — this with motions suggestive of launching a boat and setting sail; they were sorry to go, as they had been well treated; then they sail on a bit, and make pantomime of working the ship; then approaching a new island they wonder if they will be well received; they look at themselves in the looking-glass to see if they are smart enough to go on shore, and so on.

The *meke*, like every other form of poetry or song, requires certain surroundings for its development or preservation. Let us glance for a moment at the surroundings of a Fijian. He is pretty busy by day, fishing, digging yams, etc., but at night he has little to do. The great long huts are almost dark, for cocoa-nut oil is too valuable to be much burnt, and so the only way of spending the evening is by drinking

and singing. Books he has none, and he could not read them even if he had the wish to do so, while custom forbids him to consort with the women. A man who could sing or lead a chant was then an important personage, and the *meke* would flourish as a useful institution for passing the time pleasantly.

But, curiously enough, it has been observed that since petroleum came in as a cheap illuminant, singing has gone down; and it seems that men are not so inclined to sing in a well-lighted room as in the dark, or it may be that they really prefer talking to singing, only that they cannot talk so well in the dark. It is well known to lecturers with the optical lantern that there can be no discussion on anything as long as the room is darkened; the darkness seems to depress men so much that they are not inspired to speak.

Anyhow, there is no doubt that *mekes* are declining in Fiji, and probably will not survive another generation. I was very sorry that I could get but little information about these songs and other Fijian stories and folk tales; and the time at our disposal prevented us from going to visit a magistrate on the Rewa River, who was supposed to know more about these things than any one else in the islands.

When our feast was finished, about ten o'clock, the natives all left the hut, and we stretched strings across the room on which to sling our mosquito curtains. The mats on the floor served as a mattress, and each man's curtain made a sort of tent for himself. The houses were so dry and clean

that one slept with great comfort, except from the heat.

The next morning a huge turtle, cooked whole, was brought in and presented with great ceremony to the Governor. The animal was then cut up, and our party was served with the chief's portion—the tripe. This was very nasty, and the rest of the carcass, both the flesh and the fat, was anything but good. Turtle as served to an alderman is certainly one of the greatest delicacies; but turtle cooked in Fijian fashion and eaten with your fingers on a banana leaf in a climate that is not conducive to a robust appetite is quite another thing. Previously we had seen large pits in the ground, with great fires covered with stones inside them. When the fire had burnt out in one of these, the turtle had been put in whole, without being cleaned, surrounded with hot stones; then a thick coat of leaves had been rapidly spread over all, and on them a layer of earth about four inches thick. This is the way that human bodies used to be baked in the days of cannibal Fiji.

When the turtle was consumed, we first walked to a neighbouring village, and then sailed in the gig all day along the coast. At times the party landed, and perhaps walked along the shore to an adjacent village, then re-embarked, and so on, till a little after seven in the evening it arrived at the town of Sanima. Here the next day was spent doing nothing, both because it was Sunday, and because the Governor was not to enter Tavuki till all the chiefs had arrived.

Our dinner at Sanima was not such an elaborate

meal as at Mbullia, for the place was much smaller, and not ruled by so big a chief. Sunday was spent in going to church and strolling about the place. The church, as throughout Fiji, belonged to the Wesleyan denomination, and the service was also, as usual, carried on by a native teacher. The church was very much like any other house, only on the outskirts of the town. The teacher stood at a table; a few of the big men and ourselves sat at his side, while the rest of the congregation faced the table—the men on one side, the women on the other side of the building. Most of the latter wore, in addition to the customary waistcloth, a sort of garment over the shoulders. This was something in the shape of a chemise cut off at the waist, so that while the bosom was covered, there was not much inconvenience caused by the heat. The teacher first read a little bit of the Bible in the native tongue; then we knelt and said the Lord's Prayer, after which he gave a short sermon on the rich man and Lazarus with much eloquence and gesture. Another prayer and a blessing ended the service; and though one or two dogs came in and lay down anywhere, the service was conducted and followed with the greatest reverence.

There is no doubt that *lotu*—love—as the natives call Christianity, is very popular in Fiji. How far the congregation really understand dogma is very doubtful, but they appreciate the greater safety and comfort which has practically been assured to them since the missionaries gained the ascendency.

The traveller must be prepared to hear the most

diverse opinions as to the results of mission enterprise in the Pacific. By some the preachers are extolled as the most successful and self-denying of men; by others they are denounced as men who are making a living out of the poor savage, and under whom the native morality has deteriorated.

The truth probably lies, as usual, between the two extremes. There is not the slightest doubt that the early pioneers went with their lives in their hands among desperate savages, supported only by a scanty pittance from the missionary societies in England or Australia. One of the first, who laboured more than forty years ago in Vanua Levu, told me that he began with £40 a year; but now the governing body of the Wesleyan community try to make up the salaries to £180 per annum. Most of this sum is derived from native contributions. Here the opponents of the system accuse the missionaries of levying exactions from the natives, and taunt the Wesleyan as being a preacher of oil—*i.e.* because the contributions are mostly in cocoa-nut oil,—as opposed to the preacher of truth, or the celibate Catholic priest who is maintained from some European fund and takes nothing from the natives. This is, of course, a matter of opinion. The older view was rather opposed to direct payment for religious ministrations; but the more advanced school hold that such services should be paid for like any others if they are really worth having. It does, however, seem to be unfair that money raised from the Fijians should be taken out of the country, and used to

support missionaries in other islands beyond the group.

The condition of past and present morality is always a difficult and delicate subject. The Fijians were always curiously moral so far as women were concerned; and though old men tell you now that things are worse than they were formerly, old men always talk that way all over the world. Even now, with advancing civilisation, there is not a Fijian woman on the streets of Suva or Levuka; for the few there are of that class all come from Samoa. There and in the Sandwich Islands the effect of missionary influence has certainly not improved morality, which was always bad in those islands; but I can only speak from hearsay. A change of religion is always hazardous, so far as morality is concerned.

The most serious charges that have been brought against the missionaries are that they have sometimes carried the letter of their teaching to absurd extremes, even refusing to assist vessels in distress if the day happened to be Sunday; and that they have not always been friendly with traders and others. The first of these charges is undoubtedly true, and has been severely noticed by many travellers. Probably the missionaries are a little more tolerant now than they used to be, but still they are not naturally inclined that way. Traders and beach-combers are often men that no respectable person would care to associate with, and whose influence on the natives would certainly not be for the good. The missionaries would also naturally look with jealousy on any men who

were not so subservient to the teachers as the ignorant natives.

Still, in the main, the missionaries can point to good work, and say that they have converted ferocious cannibals into peaceable and orderly citizens. Twenty years ago no native could go far from his own village without running the risk of capture and death, while a shipwrecked crew of any nationality was always considered fit food for the ovens. Now either a native or an Englishman may walk from one end of Fiji to another without the slightest danger, and a shipwrecked crew would be safer than they would have been in many parts of England one hundred years ago.

The missionaries in many places have no doubt become the absolute ruling power, and though the separation of civil from ecclesiastical government is one of the fundamental features of modern civilisation, no other system is possible among semi-civilised people. After the missionaries landed and gradually got the people and the chiefs under their influence, the preacher could not otherwise than eventually obtain the supreme absolute power, and such a system would have all the defects inseparable to priestly rule. This regime was probably the best that could evolve so long as there were only natives and a few beach-combers in the community; but the case was far otherwise when the British Government annexed the islands of Fiji, and sent out a staff of English officials.

Common sense and mutual interest have, however, solved the difficulty in a very satisfactory manner.

The Government is absolutely neutral so far as the Wesleyan administration is concerned, and does not interfere between the preachers, their contributions, and the natives. The schools are even encouraged, but I believe no subsidy of any kind is paid. The Wesleyans on their side do not interfere with the native administration and policy of the Government, and though the former have a native teacher in every village, still they cannot be said to embarrass or rival the ruling power in any way. By this tacit understanding the Government has all the immense power of the missionaries on its side to keep the people from rebellion; while the missionaries are backed by a strong administration, which practically secures them from the chance of being eaten, and enables them to gather their contributions in peace.

There is an arrangement among the various missionary bodies that they shall not interfere with one another, but that each denomination shall keep to its own islands. For instance, Fiji and Tonga are entirely Wesleyan; the Melanesian islands, Church of England; New Caledonia and the Loyalties, Catholic; while the Scotch Presbyterians and several other bodies have each their own geographical limits.

On the whole, therefore, the natives have gained greatly by the introduction of missionaries, and some of the absurdities that travellers naturally comment on most severely will gradually disappear, as the light of publicity is brought to bear on men who, in spite of their self-denial and hard work, are naturally inclined to narrow-mindedness, both from the nature

of their profession and from the force of circumstances and of isolation.

The Government steamer *Clyde* picked us up at Sanima on the morning of the 4th May, and landed the party in Tavuki Bay about 2 P.M. This was a large inlet, with a very shallow shelving beach, looking to the north, and surrounded by the rocky backbone of the island of Kandavu. The water was crowded with shipping, for no less than fifty cutters and two schooners were assembled, all bringing chiefs to the great meeting or *ve bose.* We remarked there was not a single native-rigged craft in the bay, so completely has the cutter superseded the outrigged boat. Fully a mile of bushes along the sea front was covered with white strips of *masei* or bark cloth; and as each cutter arrived some of her men got out and ranged themselves waist deep in water parallel to the shore. As soon as our anchor was down the chief of the town came off to present the Governor with *yaqona,* and also to offer a whale's tooth as an act of homage and welcome. Next the Roko Tai Levu, the eldest son of the late King Thakombau, and the biggest chief in Fiji, came on board. On obtaining permission from the Governor he gave a signal, and the whole line of men raced through the water to the shore, each one seizing as much *masei* as he could and carrying it back in triumph to his own ship. The *masei* had been laid out by the inhabitants of Tavuki as a present to welcome the new arrivals.

The Governor landed after a short interval in his gig; but as the tide was out, and fully a quarter of a

mile of mud intervened between the sea and the shore, a body of natives came out and carried him on their shoulders in a canoe to the dry land. The rest of the party went ashore soon afterwards, and took possession of a house that had been built for them.

We found ourselves in a great square; our house made one side, the habitations of the greatest of the stranger chiefs formed another side, opposite to that were piles of food, while the fourth side was a row of trees, through which we could see some of the permanent huts of the town. The piles of food were a strange sight. One stack of taro was 50 feet long by 20 across and 5 high, while 60 to 80 cooked pigs were lying on the top of this heap. On the same side of the square, and in other parts of the town, no less than 400 tons of yams were stacked as food for the visitors during their stay.

The strangers were all sitting on the ground facing this great pile of food, when the chief of the town advanced towards them and formally presented the great mass to the new arrivals. Their attendants rushed on the pile with a shout, and set to work to subdivide the food among the different *rokos*—very big chiefs—in the square. When this was done the herald of the town went round, pressed his hands on each pile of pig and taro successively, and shouted out in a loud voice the name of the *roko* or of the district to which the pile had been apportioned. At a given signal each *roko's* attendants rushed at the food and carried it off to their respective houses. The eatables were then further divided among the smaller chiefs.

There are three grades of chiefs in Fiji. Every town has a chief who is called *turanga ni koro*, chief of the town. Every collection of towns has a common greater chief, or *mbulli*, like the one we stopped with at Mbullia, while every large district comprising the territory of several *mbullis* is ruled over by a very great man called the *roko*. There are more than a dozen of the latter among the islands, and the bigger ones sometimes have the additional title of *tui* or master. Thus the greatest of the chiefs is Roko Epeli of Mbau, or, as he is sometimes called, the Roko Tui Tai Levu, the *roko* or "master of the great shore." Epeli is the Fijian equivalent of Abel, a name which is due to missionary influence, for in the old days a man's name was either descriptive of his character or personal appearance, or else commemorative of some distinguished feat. For example the father of Roko Epeli was the celebrated old King Thakombau, a name which means the "bane of Mbau," because on one occasion he had burned the town of that name. Another great chief of that time was called Varani, the nearest approach in the Fijian mouth to French,—a suitable name for a warrior who had eaten a Frenchman.

The *rokos*, the *mbullis*, and the *turangas* have each certain administrative functions, such as punishing crimes, settling disputes, and raising the revenue, and are all recognised by the English Government and used by it to rule the country through native agency. All the great chiefs put on a good deal of swagger, and you can easily distinguish a chief by his manner

and bearing from the other men. In the evening we went to visit three chiefs in their own houses with Mr. Cox the interpreter. At each place a message was sent in to ask if the chief would receive us, and on receiving a satisfactory answer we entered and were introduced to, and received gracefully by, the great man. He was always sitting at one end of a long dark room with his retainers squatting round the building at a respectful distance, and after a little conversation *yaqona* was brought for a *meke* and a drink.

Our first host was Na Thangi Levu, or "Strong Wind," the deposed Roko of Kandavu. He was an ill-tempered-looking man who had gained his name by some adventure in a very strong wind; and who had recently been deposed by the Government from the post of Roko of Kandavu for irregularities in the collection of the revenue. Then we visited a big chief of the Lau or windward district—that is, of the islands near Lakemba. Here we had more *yaqona,* but drunk after the Lau custom, which differs slightly from the Fijian manner. Lau is more or less under the influence of Tongan race and civilisation, which is higher than that of Fiji. Our last friend was the Mbulli Serua, a shrivelled old cannibal, whose Fijian name was Nganga Bakolo, or "Putrid Corpse," because of some very high human flesh which he had eaten on one occasion. It is a curious phase of human nature that the Fijian, who will not touch any ordinary food if it is the least degree tainted, will eat *bakolo* or human flesh when it is almost decomposing. Nganga Bakolo looked a

thorough savage, of medium height and size, and was the only man who gave us chewed *yaqona*. He also gave us a devil, or pre-Christian, *meke* with much gesticulation while the *yaqona* was being brewed; but the language was so archaic that even Mr. Cox, the best interpreter in Fiji, could not follow the sense of the words.

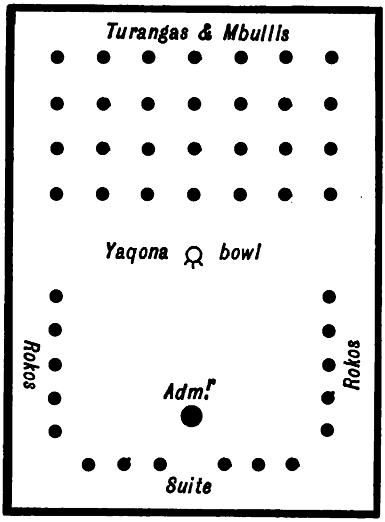
Cannibalism is now dead in Fiji. When we were there in 1885 it was ten years since any white man had been eaten, and eight years since the last native had been cooked. This was a teacher up in the mountains who persisted in going to a village that he had been warned against. The natives are now ashamed of their former habits, and it is bad manners to allude to the subject, or still worse to ask a man if he has ever eaten human flesh. We could, therefore, hear but little, and that but disjointedly, about the most characteristic and interesting custom of old Fiji. Some of the stories one hears from the old hands are obviously yarns, but still there is no doubt that the meat of white men is salter than that of black men, and that the latter was preferred by Fijian epicures. It used to be thought that the saltness might have been peculiar to sailors who fed largely on salt rations; but the same peculiarity is reputed of white missionaries and others, who do not eat an exceptional amount of salt, and from other parts of the world besides the Pacific. Human flesh was certainly unwholesome, and gave rise to colic with constipation, so that this peculiarity had to be met by taking a special herb, *solanum anthropophagorum*, a kind of night-

shade that grows in the jungle. It is impossible to say now whether this unpleasant quality was inherent to the kind of meat, or whether the ill effects were produced secondarily from the practice of eating *bakolo* without chewing. The flesh was cut into mouthfuls, put into the mouth without touching the lips, and then swallowed whole like an oyster. The forks used for the purpose were of a peculiar shape and were never used for any other purpose. Human bodies were usually cut into pieces and baked in ovens like the turtle we described before, and naturally some pieces were daintier than others. The inside of the thigh of a woman was considered the most delicate portion, and this of course is the best cut of a leg of mutton; while the back was rarely eaten, as it was too oily.

Anthropologists have always had some difficulty in explaining the origin of cannibalism. In some countries the custom has no doubt arisen from the absence of other flesh food, though there are many parts of the world where men live exclusively on vegetable diet. Still there is always a craving for flesh, and we must remember that till pigs were introduced into New Zealand and the other Pacific islands, there were no mammals to be found there. Now all these islanders eat pig enormously, in spite of the filthy habits of that animal.

Next morning we went with the Governor to open the *ve bose* or annual meeting of the chiefs of Fiji. On entering we found the room half full of *mbullis* and *turangas*, sitting on mats facing the end of the

room, where a portrait of the Queen was suspended. The Governor took his seat on a chair just under the picture, so as to face the chiefs, his suite sat on the mats behind him, and the *rokos* along the side of the room to the right and left of him. After a short prayer by a native teacher, the *yaqona* bowl was brought in and placed just in front of the *turangas.* While the liquor was being brewed from grated, not chewed, root, the old Mbulli Serua led the same



THE VE BOSE IN FIJI.

devil *meke* that we had heard last night. I asked the Roko Tui Lau what it was all about, but even he could not follow the words exactly, though the song was about the battle of Thoro and the gods. Then the formal drinking began. The Governor drank first, and when done he threw the cocoa-nut cup on to the mat with a spin, while the audience made a peculiar exclamation of approval, and called out *a matha*—it is finished. The cup was next given to the old blind Roko of Kandavu, who sat next to the Governor, then to the Roko Tai Levu, and finally to the suite and the *rokos.* These all drank separately, and then all the *turangas* and *mbullis* were served promiscuously where they sat. Some of the big men had their own

private cups, and the Roko Tui Ra, the "Roko of the Leeward," who sat next to me, offered me his own bowl, as a compliment. When this ceremony was finished, the Governor read his address in Fijian for three quarters of an hour amidst complete silence and great attention; then another teacher said another prayer, and the meeting broke up without further ceremony. All the chiefs were in their finest dresses, and many wore native *masei* or *tapa* instead of the ordinary cotton *sooloo*, but above that they almost all sported English cotton or flannel shirts, and one or two even silk neck-ties.

Now that the opening was over, the Governor would go away for two or three weeks, while the chiefs consulted over affairs of State under the Secretary for Native Affairs; and then the Governor would return to receive the report of the deliberations.

We went home after the meeting had dispersed to watch our men carrying the presents from the Government to the chiefs of Kandavu. One could not help thinking of the pictures on the Egyptian temples of rows of men carrying tribute or presents to the Pharaohs; only, instead of carrying corn or fruit, or strange animals, our men walked past in Indian file bearing on their shoulders spades, axes, knives, and other articles of hardware that are very much prized by the Fijians.

About three o'clock we went into the public square, where all the food had been distributed, for a grand singing *meke*. *Mekes* are of many kinds. There are the chanting *mekes* we have described when

brewing *yaqona*, and singing *mekes*, such as we were just going to witness, and dancing *mekes*, where extravagant dances and capers are the prominent features of the entertainment.

About one hundred men on this occasion first defiled on to the square, bringing piles of *tapa* and *masei* as presents to the stranger chiefs. They wore lengths of *tapa* tucked up over their *sooloos* till they looked as if they were dressed in petticoats. Their faces were also painted fantastically with red and black earth, as was customary in the old savage days, but rarely done now, as the missionaries discourage the practice. The men marched in, chanting and waving their hands and arms slowly. One portion of the band extended themselves in line, while a smaller portion formed a solid square behind the centre. After going on with this chanting and gesticulation for about a quarter of an hour, the men huddled themselves together under a tree in the square, while about one hundred women came in bringing more *masei* and some whales' teeth.

Whales' teeth, or *tombua*, as they are called, are much valued among the islanders, and one or more make a suitable present to a chief; but it is hard to see what the attraction is, except perhaps the rarity. Whales were plentiful in former days in Fijian waters, but now are almost extinct. Anyhow, these gifts were much applauded in a peculiar manner.

The women were very much got up with flowers in their heads and garlands of grass. Like the men, they had swathed themselves with white *masei* till

they looked as if they were wearing white petticoats, and their shoulders and breasts were rubbed with cocoa-nut oil till they shone like polished mahogany. The band formed up something like the troop of men, and sang and gesticulated in a very similar manner. Then they began to strip off their extraneous coverings of *masei;* the men did the same, and both sets retired, leaving the ground littered with the white bark. The *masei* was immediately collected by the strangers for after subdivision among themselves; and then the old deposed Roko of Kandavu brought in some mats, and about a dozen whales' teeth, amidst great applause. He made a regular oration, and then the Roko Tai Levu, after keeping the assembly waiting for a few minutes to show his own grandeur, made a suitable acknowledgment, and the meeting terminated.

It will doubtless strike the reader that all this must have been a great tax on the inhabitants of such a small island as Kandavu; but it must be remembered that the assembly of chiefs takes place every year in a different part of the group of islands. Each locality makes presents of the special article which the neighbourhood produces best. For instance, here we have seen the thin inner bark of a kind of maple which makes *masei* liberally presented, because that is especially abundant in Kandavu. In the Ra (windward) district, mats would probably have been the chief material for presents, so that these meetings really lead to a sort of interchange of manufactures. A savage never gives without the hope of getting.

After dinner we had just time to have a farewell *yaqona* and a Tongan *meke* with one of the chiefs of the Roko Tai Levu before embarking at ten o'clock at night for Suva, where we arrived at nine o'clock next morning.

CHAPTER VII

IN THE PACIFIC: THE LEGEND OF MAUI

A FEW days after our arrival at Suva we went by a small steamer to Levuka, the old capital of Fiji, on the neighbouring island of Ovalau. The journey only occupies about six hours, during which we were introduced to the new method which has been adopted for communicating between the islands by means of homing pigeons. Bananas are one of the most lucrative exports to the neighbouring colonies of New Zealand and Australia, but as the fruit does not keep well, it is of the utmost importance that information should be sent to the growers of the arrival of the steamers. So a system of communication by means of homing pigeons has been organised, both for commercial and journalistic purposes, which answers very well. The charges are necessarily rather high, for the birds cost £25 a-piece to introduce from Belgium, and the tariff for a message from Suva to Levuka is three guineas. Of course the birds have to be trained even over the short distance between these two towns, and we had a number of birds on board which were tossed at different distances from home.

When a steamer arrives from Sydney or Auckland, pigeon messages are despatched to the growers of bananas, who immediately cut the bunches of fruit off the trees and carry them in native boats to either Suva or Levuka. It is nothing unusual to see twenty or thirty native canoes round a steamer just before she leaves for Sydney.

Levuka is a much smaller place than Suva, and its natural position, jammed up between the mountains and the sea, must prevent the town from ever stretching in any direction except along the shore. The roadstead is also only sheltered from the swell of the south-east trade by the barrier reef, and in bad weather the sea is quite heavy on the beach. There is no doubt that the Government did well in changing the seat of government to Suva, for the latter town not only has a much better harbour, but also space for unlimited extension. Levuka is, however, better situated for trading with the windward islands, and there are always more small craft in that harbour than in the rival port.

One day we went out on to the barrier reef to see one of the most strange and beautiful sights in the world—the seaward side of a coral reef. The barrier reef at Levuka is about a mile from shore, and both under the shallow intervening water, and on the reef itself, the coral is dead and uninteresting. We chose low water for the time of our visit, as it is only then that the surface of the reef is so nearly dry that one can easily wade on the top. The reef was here perhaps a quarter of a mile across, but rather

irregular, and a great many native women were fishing for star-fish and other fry in the little pools which had been left by the receding tide. It was remarkable that here, as on the Navua River, many of the faces were blackened to protect the skin from the reflected glare of the sun. We all suffered very much from the heat; and between the salt water and the sun, the skin of our legs was completely burnt off by the next day. Walking was rather difficult, owing to the roughness of the surface; and to those who were barefooted, not only uncomfortable but dangerous. If small pieces of live coral break off and stick in the skin, a very nasty sore gathers on the foot when the insect dies and putrefies.

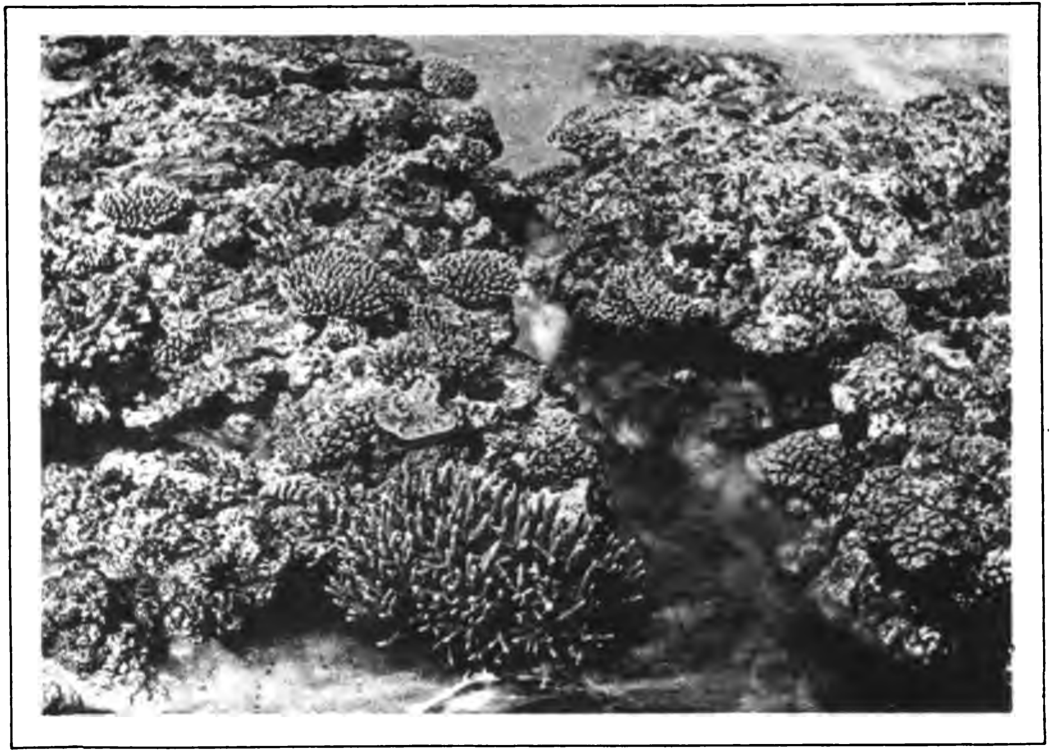
The inside of the reef was all dead, and was simply rough, uninteresting-looking, shapeless limestone with a very small covering of sea-weed. But as we approached the roaring surf on the outside, fingery lumps of beautiful live coral began to appear of the palest lavender-blue colour; and when at last we were almost within the spray, the whole floor was one mass of living branches of coral.

But it is only when venturing as far as is prudent into the water, over the outward edge of the great sea wall, that the true character of the reef and all the beauties of the ocean can be really seen. After walking over a flat uninteresting tract of nearly bare rock, you look down and see a steep irregular wall, extending deeper into the ocean than the eye can follow, and broken into lovely grottos and holes and canals, through which small resplendent fish of the brightest

blue or gold flit fitfully between the lumps of coral. The sides of these natural grottos are entirely covered with endless forms of tender-coloured coral, but all beautiful, and all more or less of the fingery or branching species, known as madrepores. It is really impossible to draw or describe the sight, which must be taken with all its surroundings as adjuncts.

The picture in Plate I, which is reproduced from one of my own photographs, gives but a very faint idea of the aspect of the top of a coral reef. It was of course impossible to photograph the grottos as seen through twenty feet of surging water, but my friend, Mr. Fraser, and myself managed to take this view of the upper edge of a grotto under considerable difficulties. No coral can live if it is exposed to the air for more than a few minutes at a time, so that the only chance is to catch a portion in the camera while the coral is left bare by the indraught of a wave. Ovalau rises, like most Pacific islands, straight out of deep water, and as there is an unbroken expanse of a thousand miles of ocean to the south-east, there is always necessarily a heavy swell, even on the calmest day. As each wave approaches, the indraught sucks down and leaves the coral momentarily bare; and then as the crest rolls over, the rocks are buried in a sea of white surf. The interval between two breakers was perhaps six seconds, so that there was plenty of time for the three-fifths of a second which the photographic plate required. The greatest difficulty was to keep the camera from being washed away; but by standing, one of us in front to hold on to the legs and work

Plate I.



A Coral Reef.

the cap of the lens, while the other focussed and worked the slides, we managed to get this picture during the brief moments that the coral was bare. The next moment we were knee-deep in water, and all the beautiful masses of coral were under the sea. However, this photograph represents fairly well the outside of the reef looking seawards. The deep inlet running down the centre is one of the beautiful grottos extending deeper than the eye can reach, and all lined with bunches of branching coral.

A good specimen of fingery coral is seen just in the foreground, and the general roughness of the top of the reef is very evident. Drops of water can be seen dripping from some of the coral masses, and the ghost of some of the beauties below the water can just be distinguished on the right-hand side of the central channel.

But the effect of all this was much enhanced by the surroundings. We were standing on a kind of natural breakwater a mile away from shore. In front, the ocean and a line of foaming breakers curled slowly over, and caught the sunlight reflected from the white limestone below the water, till they acquired that exquisite green colour that is only seen in perfection on a coral reef. Here, where one might have supposed that nothing would live owing to the force of the waves, life is, on the contrary, most prolific. On the other side, we saw in front the lifeless surface of the reef just below the level of the sea, and then, beyond the calm ring of smooth water which encircles the land, the green and rocky slopes

of the little island of Ovalau, where the cocoa-nut palms run down to the water's edge.

The sky to seaward was dotted with the small irregular cumulus of the trade-wind districts, and, near the land, became complicated and confused with the cloud produced by the mountains; while the sun blazed down from above, and was reflected with nearly equal intensity from the surface of the water.

We could now understand the great peculiarity of the scenery in the Pacific, and how the aspect of nature differs from that of other coral countries, such as India or the Malay Archipelago. Here the numberless islands rise abruptly out of the sea in a long stretch of unbroken ocean, over which the south-east trade blows without intermission all the year round. For this reason the outside sea is never calm, so that the contrast between the tumbling ocean, and the calm water inside the barrier reef, is very striking. There is no gradual shallowing of the water or the formation of rollers, but the sea takes one great green bound over the reef, and is then broken for ever.

And then the clouds tell such a distinct story. Every little island develops a crown of cumulus far over its head, while the clouds over the mountains on the greater islands mingle with the natural cloud over the sea and form a black broken mass rising high in the sky. We can often discover the proximity of an island by looking at the clouds and seeing where the natural trade cumulus is deformed, even when the land itself is below the horizon.

All this is very different from the aspect of the

Spice Islands in the Malay Archipelago. There the islands are much larger than in the Pacific, and from other causes the monsoons do not blow steadily in that part of the world, so that we do not find there the line of foam along the outside of the barrier reef. The green islands seem to grow out of a summer sea, and the natives build their houses on piles over the water undisturbed by waves or hurricanes.

As we sail among the Pacific islands, and in many other parts of the world, one often sees, just after sunrise and just before sunset, the rays of the sun streaming down like a fan, as the light shines through chinks in the clouds not too far above the horizon. A beautiful example is given in the Frontispiece, from one of my own photographs near Teneriffe. These diverging rays are not very common in England, because the sky is either too uniformly overcast or too thick to give the necessary chink through which the light can stream. But in the Pacific the clouds are habitually of the right sort to develop diverging rays, so much so that we find the following pretty story in the Hervey Islands some way to the east of Fiji.

THE LEGEND OF MAUI

Maui was the great hero of the Pacific, and had already not only discovered the secret of fire for the use of mortals, but had elevated the sky above the earth. The sun, however, had a trick of setting every now and then, so that it was impossible to get through any work; even an oven of food could not be prepared

and cooked before the sun had set, nor could an incantation to the gods be chanted through ere the world was overtaken by darkness. Now Ra, or the Sun, is a living creature and divine, in form resembling a man, and possessed of fearful energy; his golden locks are displayed morning and evening to mankind. But Tatanga advised her son not to have anything to do with Ra, as many had at different times endeavoured to regulate his movements, and had all signally failed; but the redoubtable Maui was not to be discouraged, and resolved to capture the sun-god Ra.

Maui now plaited six great ropes of strong cocoanut fibre, each of four strands, and of a great length. He started off with his ropes to the distant aperture through which the sun climbs up from Avaiki, or the land of ghosts, into the heavens, and there laid a slip noose for him. Farther on in the sun's path a second trap was laid—in fact all the six ropes were placed at distant intervals along the accustomed route of Ra. Very early in the morning the unsuspecting sun clambered up from Avaiki to perform his usual journey through the heavens. Maui was lying in wait near the first noose, and exultingly pulled it; but it slipped down the sun's body and only caught his feet. Maui ran forward to look after the second noose, but that likewise slipped through, luckily it closed round the sun's knees. The third caught him round the hips, the fourth round the waist, the fifth under the arms; still the sun went tearing on his path, scarcely heeding the contrivances of Maui;

but happily for Maui's designs the sixth and last of the nooses caught the sun round the neck.

Ra, or the sun, now terribly frightened, struggled hard for his liberty, but to no purpose, for Maui pulled the rope so tight as almost to strangle the sun, and then fastened the end of his rope to a point of rock. Ra, now nearly dead, confessed himself to be vanquished; and fearing for his life, gladly agreed to the demand of Maui that he should be in future a little more reasonable and deliberate in his movement through the heavens, so as to enable the inhabitants of this world to get through their employments with ease. The sun-god Ra was now allowed to proceed on his way; but Maui wisely declined to take off these ropes, wishing to keep Ra in constant fear.

These ropes may still be seen hanging from the sun at dawn, and when he descends into the ocean at night. By the assistance of the ropes he is gently let down into Avaiki, and in the morning raised up out of the shades; while the islanders still say when they see rays of light diverging from the sun, "*Tena te Taura a Maui*"—"Behold the ropes of Maui."

Such is the pretty story as given by Mr. W. W. Gill in his *Myths and Songs of the South Pacific*, and it would be impossible to find a simpler instance of a native folk-lore story, or a tale to account for the origin of the aspects of nature.

Here we have the story in a simple form, but Sir George Grey gives a variant of the same from New Zealand, in which all trace of nature origin is lost,

and only an elaborate heroic tale remains. Even in the version we have given, it would be difficult to detect the true origin of the story, if it were not for the colloquial expression of calling diverging rays the "ropes of Maui."

It is curious how this aspect of sunlight has attracted notice in different parts of the world. In Ceylon these rays are called "Buddha's rays"; in England country folk say when they see this appearance, "The sun is drawing water"; while in Denmark the saying runs, "Locke is drawing water." The last is very interesting, for Locke is one of the gods of the Scandinavian edda. The allusion to ropes by which the sun is drawn up from below at sunrise probably refers to the crepuscular rays, we have several times before alluded to, as shooting up from under the horizon just before the sun rises. These rays are very common in the Pacific.

I never saw a more lovely exhibition of pink crepuscular rays than in the early morning of the 15th May 1885 as we left Levuka on our way to Auckland in New Zealand. The pink sheaf of light sprang up above the green-topped mountains of Ovalau, while the sea and foreground had scarcely lost the last touch of the purple foreglow.

The *Arawatta*, in which we sailed, stayed about six hours at Suva to load bananas, and then steered straight for New Zealand. Showery weather was experienced for the first two days, with a south-east wind and the usual trade-wind sky; but on the third day she ran into a totally different climate. The air

was cool, as the wind had worked round to north-east, while a great change had come over the appearance of the clouds, for the trade cumulus had disappeared and been replaced by a firm strato-cumulus sky. Two days later we arrived in the beautiful harbour of Auckland, and were not sorry to return to the cool air, the drizzling rain, and the flat stratiform clouds that recalled our native climate, after being so long in the steamy relaxing air and the drenching showers of the Tropics.

CHAPTER VIII

TO NEW ZEALAND: THE DESTRUCTION OF THE TERRACES

THE most interesting excursion in all New Zealand is that to the hot springs of Rotorua, and the celebrated pink and white terraces of Rotomahana. There are various ways of making the round, but we selected to go by sea as far as Tauranga, to drive forty-two miles through the Oropi bush to Ohinemutu, then to visit Rotomahana, and return to Auckland by Oxford and Cambridge.

By this means we were enabled to see both the bush, and the cultivated parts of the northern island, and were saved the necessity of going twice over the same ground. Nothing can be more picturesque than the portion of the road from Tauranga to Ohinemutu, which has been cut through the bush. The jungle is nearly as dense as in Fiji, but the undergrowth is not so thick; and though tree-ferns are very plentiful, there is not the same profusion of epiphytic ferns growing on other trees. There are, however, some very curious creepers and trees in the forests, such as the "bush lawyer" and the "rata." The first is a

rather straggly, insignificant-looking plant, with longish spines, but earns its name, for he is an unlucky man who falls into the clutches of the thorny creeper. But perhaps the career of the rata is one of the most singular in all the life histories of the vegetable kingdom. A tiny seed is sometimes found in the ground and swallowed by a caterpillar not more than four inches long. Even in this early stage of existence the rata begins a history of ingratitude. The seed begins to grow, and sends out a shoot from the mouth of the caterpillar, till we have the curious sight of a twig growing straight out of the mouth of a caterpillar, as long, or longer than the creature itself. After a certain time the roots of the rata become so interwoven with the brain and internal organs of the caterpillar that the latter dies, and the rata is left alone in the world: but not for long. The plant is now the thickness of a small lead-pencil, and soon attaches itself to some gigantic tree. The tender shoot then grows quietly for many years, and climbs as a thin insignificant creeper up the great trunk of its foster-parent, looking as innocent as ivy, till at last you see the rata foliage mingling with the leaves of the supporting tree, perhaps 150 feet above the ground. Even now, when the rata leaves form bunches of green, like a cauliflower, above the head of the parent tree, you can scarcely think that the tiny stem, scarcely thicker than a bit of old ivy, would at length kill the foster-parent which has so long supported it, and eventually stand alone by itself as a forest giant. Nevertheless such

is the case. The main stem of the creeper grows nearly straight up, but sends out here and there lateral shoots which entwine the parent trunk, and become great suckers of the life-giving sap. The stem of the rata now grows rapidly, till it looks like a huge green boa-constrictor encircling the mighty giant in a deadly embrace. Then the fate of the big tree is sealed, for it cannot endure the sucking drain for long. For many years the decaying trunk helps to sustain the treacherous rata, till at length the creeper has grown into a great tree quite able to stand by itself, after killing both the foster-parents who have helped it up the ladder of life.

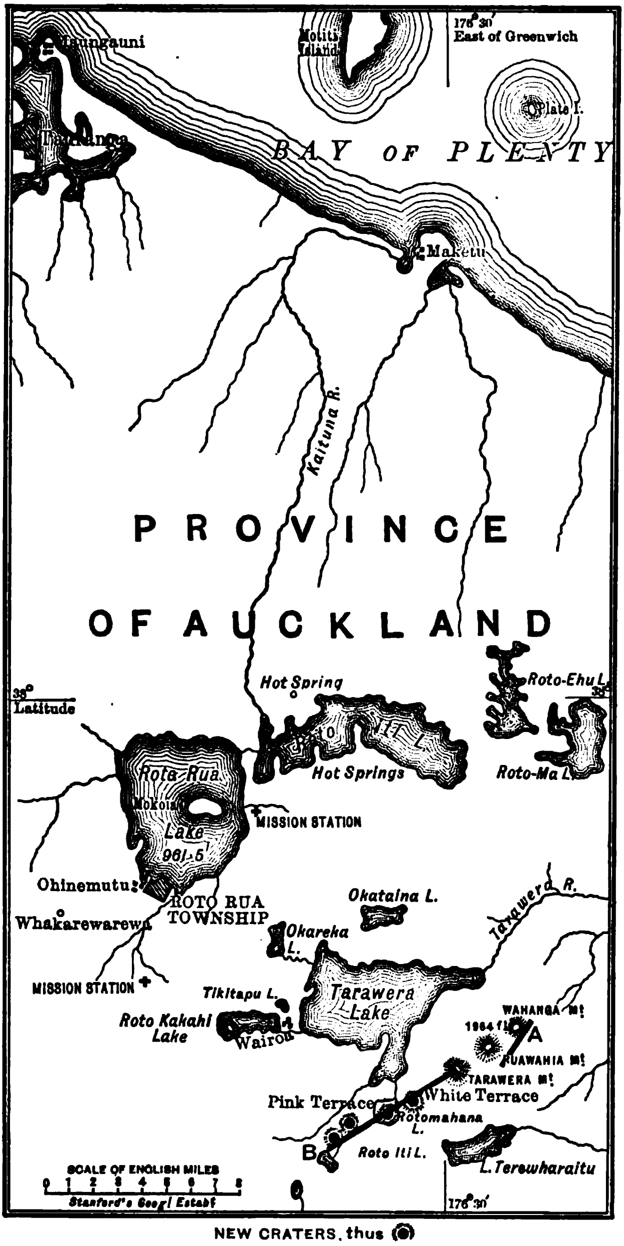
The scenery about Ohinemutu on the Lake of Rotorua is not particularly striking, though the place itself has many points of interest. The ground may be said to be simply a crust over hot springs and boiling water. Sometimes the crust breaks through, and people fall into the hot water and are boiled to death. Everywhere steam is escaping from the ground, and hot pools are met with at every step. No fires are wanted for cooking in this region; nature has supplied cooking pots or steaming apparatus for nothing, and washing tubs are equally gratuitous. A Maori has only to put a little wooden box over a hot hole to have his pig or potatoes boiled to perfection, and many of the springs contain so much sulphur and soda that soap is quite unnecessary.

Medicinal springs are very numerous, and the Government have built a regular bathing establishment at the township of Rotorua for the use of

patients and others. The natives live in the natural hot baths. At Whakarewarewa, three or four miles from Ohinemutu, the whole village live and bathe together in a great hot lake, and anywhere along the road you may come to a pool with half-a-dozen heads of various sizes peeping above the steaming water. Modesty is unknown to the Maori; all ages and sexes bathe promiscuously in a happy state of nature; but such is the custom of the country, and no one thinks anything about it.

The hot springs at Rotorua, like all others, are very much influenced by the weather and by the height of the barometer. At Tahui Te Koutu, three quarters of a mile from Ohinemutu, the temperature of the pools is from 90° to 100° with south or west winds, but the level rises four feet with strong overflow, and the temperature runs up to 180° when the wind changes to north or east. The temperature of the priest's bath at Rotorua rises four to five degrees after heavy rain. Something similar occurs at Rotomahana, where there is always more water after a north-east wind than with the wind from any other quarter.

The celebrated pink and white terraces at Rotomahana have been so often described that we do not propose to do more than allude to the circumstances of their origin, and alas, since our visit, of their destruction. There was a regular way of doing the terraces, all according to a strict tariff. The traveller drove for thirteen miles from Ohinemutu, through the township of Rotorua, and over fern-clad hills to



MAP OF NEW ZEALAND HOT LAKES.

the little village of Wairoa (see map). After leaving Wairoa, paddling up Lake Tarawera, and then walking about a mile up a narrow stream, the tourist found himself at the little Lake of Rotomahana. On the left-hand side going up he saw the magnificent series of steps known as the white terraces, and after visiting several roaring steam holes and mud geysers, and eating potatoes cooked in one of the hot springs, he was paddled across the lake by an old tattooed cannibal chief to the smaller pink terrace on the other side of the lake.

The general appearance both of the white terrace and of its surroundings will be best realised by a glance at the accompanying picture, Plate II, which is collotyped from a photograph. There we see the low sloping hill which rises above the lake covered with *manuka*, a kind of broom-scrub. A hot spring rises near the top of the hill where a little steam is rising, and the overflowing hot siliceous water forms the beautiful white step-like terraces as it falls down into the Lake of Rotomahana, 150 feet below the source. But no picture can give any idea of the beauty of the real scene. The terraces were not as if they were built up of white marble, for water from the spring above was perpetually trickling over the steps, so that they always looked as if they were newly polished. When dry the terraces were only dull white, and much less beautiful. The structure of the terraces was unique, and unlike any artificial building. The upright faces of the steps were not smooth like a marble staircase, but made up of an infinite series of thin layers one

Plate II.

THE WHITE TERRACE AT ROTOMAHANA.

[illegible]

[illegible] Water [illegible] Lake [illegible]
[illegible]
[illegible] Lower [illegible]
[illegible] going up [illegible]
[illegible]
[illegible] sloping [illegible]
[illegible]
[illegible] the [illegible]
[illegible] deep [illegible]
[illegible]

The [illegible] of [illegible] company [illegible] the [illegible] place [illegible] of the hill [illegible] Look at [illegible] give any idea of the [illegible] white marble [illegible] over the [illegible] always [illegible] as if they were [illegible] the terraces were only [illegible] beautiful. The structure of the [illegible] and [illegible] artificial [illegible] of the steps were [illegible] but [illegible] of an infinite series of [illegible] one

on the top of the other, and of an exquisitely delicate structure. All this beauty was much enhanced by the splendid colouring of the water. The admixture of very fine particles of silica was sufficient to give the liquid every shade of transparent blue and green according to the amount of solid matter in the fluid, for the illumination was both from above and below. In these shallow pools the light reflected from the pure white bottom was a large factor in the colouring of the water, for there was both the colour derived by direct reflection from the sky, and that by transmission from below through water charged with very small particles of silica. The tints derived from the scattering of light by small particles, colourless in themselves, is quite different from the hues derived from tinging water with indigo or cobalt. The latter are mere dyes, while the blueness of these pools has the transparent brilliancy of a blue sky, as the colour of both is derived from the peculiar influence of small solid particles on ordinary white light.

The origin of the terraces is of course very simple. A hot spring of water, highly charged with silica, overflows from a pool about 120 feet above an ordinary lake. As the water cools the silica is deposited as a white powder, which aggregates itself into a solid mass. The pools of water on the way down get filled up by solid matter, and so end as step-like formations with a perfectly flat top. One can easily trace every stage of the process on the spot. On the top, the hot pool of the parent spring is almost quiescent, of a beautiful blue colour, and with the sides overhung

with a crust of white silica. For this reason it is dangerous to go too near the edge of the pool, for the crust might break and the traveller fall into the boiling caldron. The water there is just below the boiling point, and every pool gets gradually cooler and cooler, till at the foot of the outflow the temperature is usually somewhere about 70°. As soon as a pool is formed anywhere in the descent, a gradual process of accretion and deposition fills it up by degrees. We can find pools in every stage of formation from a simple white basin, through a state when the edges overhang so much that they nearly meet, till a flat-topped table is the last stage in the growth of a terrace. The gradual cooling of the water, supplies a sufficient amount of silica even at the lowest level, and as a fresh supply of silica-laden water is constantly trickling over the whole set of terraces, the process of accretion is always going on.

In the pink terraces, on the other side of the lake, some of the original hot springs are charged with a small amount of iron, which supplies the material for the lovely salmon pink deposit of silica in those staircases. But it must be remembered that a great deal of the beauty of the New Zealand terraces was due to the conformation of the ground, and the steady flow of the original springs which always kept them wet, for whenever a small patch at the edges got dry, the terrace looked dull and less interesting.

Wherever there are geysers or hot silica springs, there are siliceous deposits, known technically as *sinter* by geologists, which develop more or less of the

terrace formation. There is much *sinter* in Iceland, and there are terraces in the Yellowstone District of the United States, but the latter are not so beautiful as those at Rotomahana. The precise form of any set of terraces depends on the supply of hot water, and the slope down which the fluid runs, and the conditions in New Zealand seem to have been more favourable for the development of beauty than elsewhere.

But the pride of New Zealand has passed away for ever. Little more than a year after our visit, about ten minutes past two in the morning of 10th June 1886, a semi-volcanic outbreak was ushered in by an eruption from the top of Wahanga (see map), attended by a loud roaring noise, and by slight earth shocks. In a few minutes this was followed by a similar, but more violent, outburst from the top of Ruawahia, the middle peak of the range, and after a short interval this phase of the eruption culminated in a terrific explosion from the south end of Tarawera range, north-east of Rotomahana. For nearly two hours this disturbance was accompanied by the ejection of vast quantities of steam, pumice dust, and hot stones, forming huge towering clouds, illuminated by lightning flashes; and during this time a great crack was formed along the east face of the Tarawera range, marked "A" on the map. Shortly before 4 A.M. the second phase began. A violent outburst, of a totally different nature, was experienced, accompanied by loud reports that reverberated through the atmosphere to enormous distances. An immense volume

of steam, carrying pumice dust and fragments of rock to an enormous altitude, proceeded from the site of Lake Rotomahana, causing the formation of a dense cloud in the higher atmosphere that spread in different directions, its advancing edge being marked by electrical discharges of the most striking character. At first the wind was from the south-east, and the inhabitants of Rotorua appear to have been terrified by the approach of this hideous cloud. Then the wind suddenly sprang up from the south-west and arrested the progress of the cloud in that direction, turned it off to the north-east, and at the same time condensed the vapour of the cloud to such an extent that the suspended solid matter dropped on the earth in the form of mud, smothering the country, and leading to the disastrous results experienced at Wairoa. In only four hours all the mischief was done, for by 6 A.M. the period of active eruption had closed.

At Wairoa the results were far more appalling than at Rotorua. The great black cloud rained down hot cinders of pumice stone and boiling mud on the doomed village. Many of those without doors were either killed on the spot, or buried alive, to die immediately a death of agonising suffocation, and not even all those gathered under the sheltering roofs of their dwellings escaped. Mud, stones, and cinders fell in a very deluge on some portions of the township. Roofs were smashed in, the buildings levelled to the ground, and the unfortunate inmates buried amid the ruins under several feet of scalding mud. An English visitor took refuge under the verandah of the well-built hotel

where we had spent two nights so comfortably, when another downpour of mud, ashes, and cinders fell upon the hotel, levelled it to the ground, and buried the mangled body of the tourist under its ruins.

An examination of the ground after the eruption showed that this second phase was associated with the formation of an immense fissure in the ground extending nearly five miles in a straight line passing through Lake Rotomahana. Dr. Hector, the Government geologist of New Zealand, describes the aspect of the scene a few days later, and says that, as far as he could see, the fissure appeared to have a nearly straight boundary of undisturbed ground on its eastern side. The west side of the fissure, on the contrary, was very irregular in outline, and was being continually altered in contour by the falling in of its precipitous walls, as the hills were undermined by the action of powerful geysers, seven in number, which at irregular intervals threw up great volumes of boiling water, with stones and mud, to a height of 600 to 800 feet from the bottom. He found it difficult to form any idea of the nature of the bottom of the fissure, but it seemed as if it was entirely occupied by a large circular area of mud, seething and boiling in such a fashion as to convey the impression of its being in a very liquid state. The largest of these mud geysers appeared to be that rising from the position formerly occupied by the pink terrace, so that we must fear that beautiful object has been hopelessly destroyed.

It is very noticeable that no lava was ejected, and though pumice is of course only lava blown into froth

by steam, it seems probable that a great deal of the ejected pumice was only the old pumice which was already in the ground from former outbreaks. No glow could be seen at night on the clouds over the eruption, nor any signs of molten lava below. Everything, in fact, points to the conclusion arrived at by Dr. Hector that the eruption was a purely hydrothermal or steam phenomenon on a gigantic scale, but merely local and not deep-seated. The Tarawera mountain, which was formerly a volcano, had for ages been capped with obsidian, a sort of glassy lava, forming, as it were, an enormous dome hermetically sealing the vent of the crater. The pent-up forces have now blown this dome away. The tremendous explosion shattered the tubes of the geyser springs which fed the terraces from thousands of feet below in the superheated regions of the earth. Into this region the whole of Lake Rotomahana was let down, and generated an inconceivable body of steam, which simply blew the entire valley and adjoining river into the air. What was formerly the lake is now occupied by numerous mud volcanoes, some of them 600 feet high and 300 across, belching forth mud and stones to a height of 100 feet or more. If this volcanic activity continues unabated, the district will perhaps afford in the future greater attractions to the tourist than even the vanished terraces, with all their matchless beauty.

CHAPTER IX

ROUNDING CAPE HORN: BIG WAVES

After visiting the terraces of Rotomahana we returned to Auckland for a few days, and then ran down the coast in a local steamer as far as Wellington, to embark for London by way of Cape Horn and Rio Janeiro.

The journey down the coast presented nothing of particular interest, though much of the scenery is pretty and mountainous; but we had a specimen of New Zealand wind just before arriving at Wellington. The morning had been dead calm, but suddenly the wind sprang up and blew furiously. The sky was broken and covered with dirty-looking cumulus, showing fragments of rainbow, while cirrus floated at a higher level. The land to windward was mountainous, so that as the gusts rushed down through the gullies and struck the water, they raised little whirlwinds of spray that looked at a distance like the smoke of hot springs rising out of the sea. It was a very striking and beautiful sight when combined with the wild sky overhead, through which the rays of the sun flashed divergently over the dirty misty gloom on to the seething spindrift below.

I once saw similar whirlwinds of spray raised by gusts coming off the Apennines between Leghorn and Civita Vecchia, only then with a cloudless sky. It was strange to an Englishman to see the sea a mass of foam with a beautiful blue sky overhead; but the surroundings in New Zealand made the total effect of the scene there more impressive than the view in Italy.

I attempted to ascertain the velocity of some of the gusts by measuring the interval of time that one of the cat's paws on the water took to traverse a short known distance. The observations only gave a speed of about 30 miles an hour, but this merely shows how little figures can really express the real character of wind or weather. A bald report — wind west, velocity 30 miles, irregular; sky 8-10ths covered; cumulus,—would convey but a lifeless description of the weather we actually experienced.

At Wellington one could readily understand the local joke, that you can tell a Wellington man because he always puts his hand instinctively to his hat as he comes to the corner of a street. The town of Wellington is surrounded by hills, and the gullies seem to converge on the city; so that the gusts sweep down on to the streets with extreme violence, and then tend to ricochet upwards off the ground. This of course makes it difficult to keep a hat on your head, and an umbrella would be blown inside out in a moment.

There is a mountain railway near Wellington, with a centre-raised rail to help the engine to drag the

carriages up the hill; but even in spite of this, the authorities have been obliged to put up strong palisades across gullies in two or three places, to prevent the cars from being blown over by the wind. Carriages were upset several times before this protection was erected.

We were only a few hours in windy Wellington, and as it was blowing furiously and raining hard all the time, and as it was Sunday in addition, it was impossible to see much of the city before embarking on board the S.S. *Tongariro* for London. Our life was very uniform for the next eleven days till Cape Horn was rounded. We experienced nothing but westerly winds, sometimes only strong, at other times rising to the force of a moderate gale; and always a tumbling sea, sometimes moderate, other times tolerably heavy. The sky was equally uniform in its general character, and composed of soft ill-defined cumulus or strato-cumulus, with occasionally stripes of cirrus floating far above. If the wind turned a little towards the north-west, the sky grew dirtier; and when it backed to south-west the sky grew harder with firm masses of cumulus over rain, or hail, or thunder squalls.

The weather was, in fact, the exact counterpart of winter weather in the Atlantic, only that the wind turned from north-west to south-west instead of from south-west to north-west, as we are accustomed to at home; the month of June here being the equivalent, for climatic purposes, of the month of December in Great Britain. This latter fact made the voyage

more trying to some, for the days were short and the weather cold, generally ranging from 30° to 40°. We never had either a really hard gale or a really heavy sea, but it was also never approaching either to a calm air or to smooth water. If the ship had sailed the shortest, or great circle route, from Wellington to the Horn, she would have had to run into latitude 60° south. This would have been to a certain extent dangerous, as she might have met with floating ice, and probably with such heavy seas that she would have been damaged, without being in any danger. She therefore sailed what is called a composite course—that is, a route somewhat shorter than the straight line on a Mercator's chart, but a good deal longer than the great circle.

I found in Australia that great circle sailing had been practically abandoned, as the wear and tear of the ship from bad weather more than counterbalanced any gain from saving time by traversing a shorter route. The brave west winds of the Southern Ocean do not blow so steadily south of 50° south as they do north of that parallel; and though the gales may be stronger at times, they are often succeeded by intervals of calm, fog, and, curiously enough, of thunder. Then if we add to that the increased dangers of ice, and of being battered by the heavy seas, together with the inconvenience and discomfort to passengers caused by the cold, the spray, and the short days, we can readily understand why the route which is best in theory has been abandoned by practical men. The ships carrying Government emigrants are

now in fact forbidden to go south of 45° south between England and Australia. Of course coming home they have to go down nearly to 56° south to round the Horn; but they do not generally make all their southing till they are within a few hundred miles of the South American coast.

I was very anxious to make some measurements, both of the velocity of the wind, and of the height of the seas in these latitudes, and succeeded very well, though we did not experience any extremes of either. The results pointed to the speed of the wind being less, but the height of the waves being greater than is usually supposed.

Wind velocity at sea is usually gauged by estimation in an arbitrary scale, on which 0 would be calm, and 12 a hurricane; but we can sometimes get a moderate determination of the speed by measuring the direction in which the smoke trails from the funnel, when combined with the direction of the wind, and the speed and direction of the ship's motion. I stood near the funnel, and determined with a compass the directions of the wind, the ship's motion, and the line of her smoke; then knowing how many knots the ship was running, it was easy to calculate the speed of the wind. I made several determinations, and the highest velocity obtained was only fifty miles an hour, while the general rate seemed to be about thirty miles an hour. This last would be about six on Beaufort's scale, but I think most men would have reported the wind as a little stronger, perhaps as seven on the same notation.

The measurement of the height, length, and velocity of the waves was rather more difficult. The length and velocity were ascertained by standing on deck with a chronograph of that modern construction which measures time to one-fifth of a second, and sets itself to zero when the observations are complete. When the crest of a wave touched the stern, the long seconds hand was started off. Time was noted when the crest reached the bow, and the instrument stopped when the crest of the next wave touched the stern. Then, knowing the length of the ship, her speed and course relative to the run of the waves, the velocity of the wave and its length from crest to crest could be easily calculated. The only difficulty was with the waves themselves. We never had a heavy enough gale to raise one of those long regular seas where you can see a trough a mile long rolling steadily along; for our seas on this voyage were always more or less broken by two or three waves of different lengths crossing and interfering with one another, so that the distance between any two successive waves was never the same. However, such as they were, the waves seemed to run from twenty-nine to forty-seven miles an hour, with a length of from 358 to 507 feet from crest to crest, and a time interval between two successive crests of from fourteen to nineteen seconds. One wave gave the exceptional length of 765 feet, but this was caused by the interference of two really distinct sets of undulations.

The height was more difficult to determine. There was not the slightest difficulty in observing the total

lift, or rise and fall of the cabin window. Any good aneroid will show differences of height amounting only to a single foot, or one thousandth of an inch of mercury; but there was no certain way of estimating the height of the window from the water when the reading was taken. The water might be 6 or 7 feet below the porthole in the trough of the wave, while the window might be buried 2 or 3 feet under the sea as the crest rushed by. I had to make the best guess I could of the position of the water level at each observation, but still I think that the observations are good within 5 feet. The heights I recorded ranged from 21 to 46 feet from trough to crest. The last height was certainly exceptional, but there was 40 feet of barometric lift for certain, even if my estimate of 6 feet for the difference of level at the two observations is erroneous. A good many waves, however, reached 30 to 35 feet.

Different observers have obtained very different results in wave measurement. Scoresby found a height of 42 feet, with a length of 550 feet; while Ross in the Southern Ocean measured waves up to 36 feet in height, with crests 340 feet apart as a maximum and running up to thirty-two miles per hour.[1] But the discrepancy in the results does not necessarily mean inaccurate observations. I am certain that a man does not see often, in a lifetime spent at sea, waves that are really running, as it were, true—that is, with a long straight trough undisturbed by crossing seas, and no two irregular sets of waves would ever be the same.

[1] There is some uncertainty about Ross's figures.

Single-handed I could not measure the length and height of the same wave, but only take a series of lengths on deck, and then a series of heights immediately afterwards down below. Three observers would be required for a satisfactory determination of waves, one for the barometer, one for the chronographs, and a third to estimate the height of the deck from the water and record the readings of the various instruments.[1]

I also made several efforts to photograph the forms of clouds, but only succeeded on one occasion; for the amount of light at this season of the year in such high latitudes was insufficient for the rapid exposure which is necessary on board a tumbling ship.

An amusing incident occurred on one occasion. A top-sail had been split by a squall; the weather was very cold, with snow or hail showers; the sea rather high, and the ship rolling a good deal. With the assistance of a friend, who held the legs of the camera while the plate was being exposed, I succeeded in getting a good picture of a cumulus cloud with a foreground of 21 men on the top-sail yard. They had a long job, shifting and replacing the split canvas by a new top-sail, and when they came down some one remarked that a passenger had been photographing them. "Well," said an old sailor, "if he could have photographed our language, he would have made a very pretty picture."

We rounded Cape Horn on the 20th of June, and

[1] For full particulars see Abercromby on "The Height, Length, and Velocity of Ocean Waves." *Phil. Mag.* (April 1888), p. 263.

then realised how well the ship had been navigated. There had been no observations for two days owing to bad weather; the sea was high, and a moderate north-west gale was blowing. Still at noon we were told that she would be abreast of the Cape at 2 P.M.; and sure enough just about that time we saw the Horn through the driving mist and spindrift, looming on the port bow against the low dirty sky.

This celebrated headland with its surroundings, made up a wild and striking spectacle of storm and gloom, with a background of the snowy mountains of Terra del Fuego.

The interest of this part of the world lies in the glacial phenomena, for here, in the latitude of Newcastle, England, we find glaciers almost at sea level; while in the island of South Georgia, about 1000 miles to the east, all the conditions of the glacial period are now in full development.

Any discussion of the meteorological conditions of a glacial epoch would of course be out of place here, but the most casual traveller would notice at once that here at mid-winter, though the cold was not intense, a great deal of snow would be precipitated. At mid-summer the heat is not very great and the sky is usually overcast, so that the accumulation of winter snow is but little melted. In fact, a great deal of snow and a generally low, but not necessarily freezing, temperature are the most favourable conditions for the development of glaciers.

A few hours after passing Cape Horn we turned north through the Straits of Lamaire; there was a

sense of relief at getting into smooth water after tossing so long on the waste of sea that stretches round the world in the Southern Ocean. The appearance of the sky, and the climate generally, underwent a sudden and striking change, for the dirty horizon and hazy cumulus were replaced by high cirro-stratus and cirro-cumulus with a keen air.

The next day, as the *Tongariro* ran between the

FLEECY CLOUDS NEAR THE FALKLAND ISLANDS.

Falkland Islands and the mainland of South America, the change of climate continued. The weather was simply magnificent, with a smooth sea, and about noon, one of the most lovely fleecy skies I have ever seen. This I succeeded in photographing, but neither the original negative, nor still less the reproduction which is here given, can convey the slightest idea either of the delicacy of the fleecy structure or of the brilliancy of the white cloud against the blue sky.

Our course was now nearly due north, and every day the weather grew warmer and finer. On the night of the 25th June, five days after passing the Horn, we got into the region of beautiful sunsets. One night towards the end of the first afterglow, the purple light tended to form an arch round the sun, which was then below the horizon. Venus, as the evening star, was exactly in the centre of this arch; Jupiter was shining brilliantly just outside, while the full moon was rising in the opposite quarter of the heavens; so that the effect of the whole was singularly beautiful.

The next night was almost equally lovely, and we saw Venus set in a sea of red, under the second afterglow, more than fifty minutes after the sun went down.

Two more days and the ship was snugly at anchor in the justly-celebrated harbour of Rio Janeiro. We had heard so many places called the finest harbour in the world, that we had become a little sceptical as to what Rio might be like; but the reality surpassed all expectations. As you turn into the harbour there is a conical eminence on the left called the Sugar Loaf Hill, which is curious in so far that the north side is barren, while the southern face is covered with tropical vegetation. This is the effect of the sun, which scorches up everything on the northern face, while the other side has sufficient shade to allow plants to grow. Here the sun is an enemy and not a friend as at home, for in England many fruits will ripen with a southern aspect, but die if exposed on the northern side of a

Plate III.

RIO JANEIRO.

wall. Still [illegible] north, [illegible]
Arctic coast of North America [illegible]
confined to [illegible]
of [illegible]
[illegible]

[illegible]

[illegible] outline, [illegible] by the [illegible]
height by peeping from above [illegible]

The Bay of Naples, and Sydney [illegible]
supposed by their admirers to be [illegible]
places in the world, but from a [illegible]
view Rio Janeiro bears away the palm. Naples is
beautiful, with the volcanic cone of Vesuvius rising

wall. Still farther north, in Melville Island, on the Arctic coast of North America, vegetation is exclusively confined to the southern shores which get a few hours of sunshine, while the other side of the island is entirely sterile.

Passing Sugar Loaf Hill you enter the land-locked harbour of Rio,—a combination of many beauties. Looking towards the town the city of Rio Janeiro stretches for miles along the bay, surmounted by many picturesque hills, especially so by the one called Corcovado. This hill will readily be recognised in the accompanying reproduction of a photograph taken from the deck of our ship, by its peculiar steep, almost overhanging slope, near the summit. The effect was enhanced by the magnificent cumulonimbus cloud hanging over the city, which is but feebly reproduced in the figure. The view is blocked at the western extremity of the harbour by the remarkable range of the Organ Mountains, some 8000 feet high, whose rocky crests have been weathered into vertical pillars of stone, which are supposed to look like the pipes of an organ. They were so covered with cloud and mist, even in this the cold dry season, that we could only dimly see their outline, magnified by the mist, and exaggerated in height by peeping from above the clouds.

The Bay of Naples, and Sydney Harbour, are each supposed by their admirers to be the most beautiful places in the world, but from a cosmopolitan point of view Rio Janeiro bears away the palm. Naples is beautiful, with the volcanic cone of Vesuvius rising

gracefully out of the side of the bay; but the hills about Baiae and Capri are not high, and the vegetation is neither luxuriant nor brilliant in colour.

Sydney Harbour is broken into picturesque coves, and is very striking to any one coming down from the monotonous scenery of the interior; but the highest hill in the immediate neighbourhood is scarcely 500 feet high, and the Blue Mountains, though nearly 4000 feet in altitude, are a long way off. The clouds are usually flattish, and the vegetation unattractive, for nothing in the world can make gum-tree scrub into a thing of beauty. But in Rio there is on one side the bays and coves of Botofogo and of the various suburbs, with the towering pinnacles of the Organ Mountains on the other, both clothed with the most luxuriant verdure—palms and bananas and innumerable other beautiful forms of plant life,—while overhead, massive rocky clouds develop on a scale unknown outside the Tropics.

A night on shore was a pleasant relief from the noise and dust of coaling, and really Rio at this season is neither particularly hot nor unhealthy. The well-to-do people dress in thin black coats and the ordinary tall black hats of European capitals. Sun hats or helmets are unknown, but no one seems to suffer from the sun, though this is perhaps because they do not expose themselves so much as English people in India. Unfortunately yellow fever breaks out every summer in a more or less intense form; and then this part of the country should be avoided, not

only for its own unhealthiness, but also on account of the irksome quarantine that is imposed on arrivals from Brazil in many adjacent ports.

We left Rio just before noon on 28th June for Plymouth. The sky was almost cloudless and the breeze very light from south-west; but soon after passing the outer lighthouse there were three or four tremendous rolls from a tidal wave. This is very common here, and occurs in other parts of the world. The tide for some reason or other comes in as a bore, or big wave, or series of waves, instead of simply rising steadily more or less quickly. A package of caustic soda in the store-room was upset by the sudden roll and set fire to something, but the fire alarm was given and the whole affair over in a few minutes. Still the slight alarm was sufficient to develop a severe nervous fit in a delicate girl on her way home from New Zealand. She fell into a comatose, almost cataleptic condition for more than a week, and seemed as if she was going to drop off, when suddenly, as usual, the access of nerves passed off, and she was fairly well before the end of the voyage. Similar nervous seizures are not uncommon on board ship in the Tropics, and sometimes in an emigrant ship they become quite an epidemic. When one woman breaks out, perhaps a dozen others will follow suit in twenty-four hours. These mental epidemics can be readily checked and cured by suitable moral treatment, but they are very interesting illustrations of mental and nervous health. The heat—for cases seldom occur in cold weather,—the close association of a large number of women, together

Plate IV.

Tropical Sunset.

But the curious thing was that the sea seemed to be higher under the showers than elsewhere, and it looked as if the sea was lifted in a dark wave under the places where the rain fell from the clouds. I have endeavoured to indicate this very imperfectly in the figure by drawing a dark line under the lines that represent rain. I have very little doubt that the apparent lifting of the horizon under the dark cloud was an effect of light and shadow, but I am not prepared with a detailed explanation of the manner in which this was effected, as the whole appearance only lasted a few moments, and there was not time to observe the surroundings minutely.

The same evening, after passing the lighthouse of Abrolhos Island, the appearance of flying-fish showed that the vessel was getting into warm water, and two days later the Brazilian penal settlement of Fernando de Noroña was sighted, about 4° south of the Line. Near here I got a beautiful picture of tropical cumulus, reproduced from the photograph in Plate IV. There is a peculiar turreted form and a firmness of outline that are unknown at home, while the rather heavy cirrus stripe at the top of the picture was singularly beautiful when it reflected the changing hues of the setting sun. Next day—3d July—we crossed the Equator. I calculated the actual moment we should cross the Line from the ship's place at noon, and succeeded in taking a successful photograph of clouds at the moment, but the picture was otherwise uninteresting. Hitherto our course had lain so near the Brazilian coast that the clouds had not assumed

the ocean type, but now we were surrounded by beautiful detached cumulus of the true trade wind character. The wind for the same reason had been light and variable from points of east, with smooth sea and the temperature gradually rising to about 80° in the middle of the day. This no doubt represented the south-east trade zone, but next day we entered the doldrums in a very striking phase of weather. All morning the wind had been light from east-south-east, with a few small detached cumulus, and a certain haziness about the horizon. The ship's place at noon was in 4° 28′ north latitude, 28° 20′ west longitude, and at half-past two in the afternoon the sky began to look very black to the north. In another hour it was very ominous in the same quarter, and directly afterwards we were struck by a moderate squall, with very heavy rain as the wind went round to the north-west. This lasted for about two hours, when the rain ceased, but the sky remained dull and overcast, while the wind went to north or north-north-east.

We were now fairly in the doldrums, and in the track of ships both coming from and going to England, so that a very considerable number of large Indian and Australian vessels were sighted. For some reason or other it has been found that ships get across the doldrums much easier in this than in any other longitude, so that the whole traffic is crowded into a comparatively narrow portion of the sea.

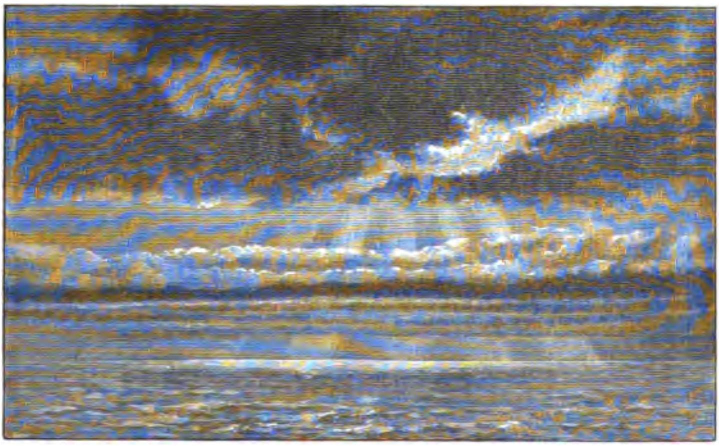
The next day we were still in the doldrums, and experienced the hottest day in the voyage, for the

thermometer rose to 82°. I was much surprised to find the weather so fine, as there was no rain, but only a little poor-looking detached cumulus floating lazily in a hazy sky with a few wisps of almost motionless cirrus, or occasionally a few flecks of fleecy cloud. It is remarkable that even in the doldrums one should so often have a clear sky even if the air is steamy and hazy.

There was such a heavy swell from the north-east that our captain thought the north-east trade must be blowing very strongly, so he altered our course to take us inside the Cape Verde Islands. The next day, in about latitude 14° north, the wind, having been south-east in the morning, suddenly shifted to north-east, driving big masses of low rainless scud before itself, and we instantly knew by the chilly air that the ship had entered the true north-east trade. For the next two days she was plunging and pitching into a fresh trade wind, with a hazy sky and irregular clouds, mostly of the strato-cumulus type; and on the third day passed close to the celebrated Peak of Teneriffe. The view was disappointing, for the volcanic cone rises more gradually than I had anticipated out of the sea; so that it is not a very imposing object, and does not in the least look its real height of over 12,000 feet.

The haze, which is such a marked peculiarity of this part of the ocean, did not appear to rise more than half-way up the peak; and this, with other things, makes it extremely probable that some of the obscuration is due to sand from Africa being driven

out to sea for hundreds of miles by the perpetual north-east trade. More than twenty years ago the well-known astronomer Professor Piazzi Smyth spent some months making astronomical observations on the top of Teneriffe, and he found that above 9000 feet he seemed to be over most of what he calls the dust haze, and that the definition of his



BARS OF CLOUD (STRATO-CUMULUS).

instruments was immensely improved above that height.

The north-east trade is the exact analogue of the north-east monsoon in the Indian Ocean, but the character of the clouds was quite different. Instead of the beautiful detached cumulus, whose heads diverged from, or converged to, a particular point of the horizon, the sky here was covered with what looked like rolls of cloud. Overhead there were nothing but irregular patches of flattish cloud, but whichever way you turned you saw nothing but

long rolls of cloud towards the horizon. There was no convergence of these rolls like the stripes of cirrus one so often sees at home, but the sun seemed to stream through them in places as if through the louvres of a Venetian blind. The accompanying illustration is engraved by the celebrated artist Mr. E. Whymper from a photograph which I took the day after passing Teneriffe. The top of the picture shows the irregular character of the cloud overhead; but the rolls soon commence and get thinner and thinner the nearer we approach the horizon, while a sheaf of rays can just be detected diverging from the sun's place behind the dark cloud. A glance at this will explain the origin of the roll-like appearance, for it is obviously simply the effect of looking at flat masses of cloud end on as they approach the horizon. Overhead we notice the flat underside of the thin masses of cloud, while near the horizon we only see in perspective their thickness like an irregular roll. The very fact of the rolls being only observed low down, and of their following us whichever way we look, would at once prove that the appearance is subjective, or belonging to ourselves and not to the cloud of itself. The name of roll cumulus has unfortunately been applied to this cloud, but this is a misnomer, and more to be regretted because there really is a roll-like cloud often formed before certain kinds of thunderstorms, pamperos, and what they call in Australia "southerly bursters."[1]

[1] For much information about these clouds see Abercromby, *Weather*, pp. 253 and 266.

The trade was strong against us right up the coast of Portugal, and did not die away till the Bay of Biscay was reached. This we crossed in a dead calm, and on the 14th of July ran into Plymouth Sound, and our voyage was at an end.

CHAPTER X

IN THE ARCTIC CIRCLE: THE MIDNIGHT SUN

A FEW weeks after the completion of the voyage described in the last chapter we set off for Norway and the Arctic Circle. Our object was to see whether there was any striking change either in climate or in the appearance of the sky and clouds, beyond the limits of the Atlantic weather system — a system which dominates even the extreme north of Norway, —and to visit the White Sea in the true Arctic zone.

We left Hull on the 28th of July, and arrived at Bergen in about thirty-seven hours. It was evident at once that the scenery was different to any which had been left behind in England, for the coast-line was cut up into fiords like the West of Scotland, only on a larger scale. Even here there was no absolute darkness at midnight; and the clouds, though of familiar British types, were softer and less well defined.

A day was spent pleasantly walking about the town, though Bergen is a very rainy place, and it is popularly said that you can always know a Bergen

man because he holds his hands clasped with the thumb up, as if he were grasping an umbrella. I noticed here for the first time, what one sees so often in sailing up the coast, immense wind vanes, perhaps eight or ten feet long, erected on the top of some neighbouring mountain, to let the fishermen in harbour know how the wind blows outside. All the Norwegian ports are situated in fiords with steep mountainous sides, and it is impossible to tell in these land-locked harbours which way the wind may be blowing out at sea. But by putting a large vane on the brow of a headland, where the instrument is both exposed freely to the wind, and at the same time readily visible to the inhabitants of the town, the necessary information can be obtained.

It is easy to see while sailing along these coasts why navigation developed early among the Norwegians, and how they naturally became the piratical scourge of Europe in the Middle Ages. Every fiord, and every inlet of the coast is a natural harbour, and when a rover came in from the sea he had only to sail up comfortably to his own dwelling. There was no having to land in a heavy surf, or to haul up his vessel laboriously as along the English coasts; but the moment he got inside the fringing line of islands, he was in smooth water away from seas and surf. It was therefore very easy both to set sail and to come back again, and people took kindly to a seafaring life. There was also little to be made in Norway from the land, for the rocky soil was barren, and the climate little suitable for raising corn. In

fact the very word Viking means a man who lives in a Vik or bay, and the word survives in our Scottish town of Wick and in many other place names.

Bergen was about the northern limit of settlement in Norway during the Viking days, and it was from there that many piratical expeditions set forth to harry England and to settle Iceland. But after the abolition of piracy, the importance of Western Norway diminished, till at the commencement of this century the country had fallen to the very lowest depths. Latterly however, since the introduction of steam, living has become more possible on these barren shores, and now the country is decidedly prosperous.

We left Bergen in one of the coasting steamers for a forty hours' run to Trondhjem, calling at Molde, Christiansund, and many smaller places on the way. Our object was not to visit the fiords at present, but to run up the coast to Vardö, and try to get a steamer from there to Archangel in the White Sea.

The general character of the scenery for nearly 1000 miles, from Bergen to North Cape, is very uniform, and a detailed account of the eleven days occupied by the journey would merely be a repetition of how we ran up and down fiords, and in and out among islands in perpetual daylight. The great mountainous plateau of the Dovrefjeld, which runs the whole length of Norway, ends abruptly in the sea, and the edge of this table-land has been cut by ice into the well-known steep-sided fiords, and into innumerable small islands outside the immediate coast

line. This makes the charm of cruising up the coast of Norway, for the islands form a natural fringing breakwater, so that one always sails in a smooth sea; and the water is so deep close inshore that one is constantly almost touching the most picturesque rocks or headlands. The voyage also presents many points of interest to the meteorologist, for he will always find much to remark in the endless varieties of cloud and mist on the fell tops, and in the phenomena of a nightless season; while every rock shows by its characteristic rounding and scratching, the former great extension of ice in the glacial epoch.

There were some very beautiful effects of mist on our way to Trondhjem. Sometimes the mist seemed to be formed by a rising wind, and sloped upwards, while at other times it seemed to be blown from the top or edge of the fell, and to curl downwards. Another time, while the mist formed as usual on the top of the hill, the summit of the cloud was quite smooth, instead of being rocky or lumpy, as might have been expected.

The steamer called at Molde about 2 A.M., and it was very curious to see everything then in daylight, and people going about as if it was midday, instead of only a little past midnight. About 7 P.M., while running up the fiord to Trondhjem, we saw a beautiful specimen of a "cloud ship"—that is to say, long stripes of thin cloud, converging both in the north-east and south-west, till the whole bore a fanciful resemblance to the strakes of a ship bending towards the bow and the stern. This phase of cloud formation, which is

called in England and Sweden "Noah's ark," and in the Rhine district of Germany "Mary's ship," has doubtless given rise to the idea of many mythological ships. Here we watched the various effects of twilight till half-past one next morning, and nearly all the time the same linear arrangement of the clouds continued. Sometimes they lay in straight stripes; sometimes they gathered themselves up into a row of lovely fleecy flecks of white vapour. These were all high up in the heavens, but below a table-cloth of white mist lay on the top of the fells, though the fiord itself was perfectly clear. Soon after midnight the clouds lost their beautiful outlines, and some soft stratus formed and rested on the former table-cloth of mist, till by eight o'clock in the morning, light rain began to fall from a thinnish flat cloud.

There was a little delay about getting Russian passports at Trondhjem, but after two days we started in another steamer for North Cape and Vardö. The scenery was of the same character as before, only here the peculiar rounded form of the low-lying rocks attracted attention at once. This was the result of the curious working away of rock by the passage of glaciers, which produces the form that the Swiss call "*roches moutonnés*." Sometimes the rocks show long scratches, where the glacier has rolled a stone between itself and them. It takes centuries for this rounding to be obliterated. Here we have glaciers often in sight, but in Scotland, where similar rounded rocks and scratchings are found, glaciers have disappeared for thousands of years.

There is one great difference between the scenery here and that in the west of Scotland. You do not see in Norway a wide beach of rocks covered with sea weed, for here there is only three or four feet of tide; and as the sea is never rough inside the fiords, the trees grow down almost to the water's edge. The houses of the peasants are also painted bright red or yellow, so that if you were dropped down suddenly from the clouds on the west of Norway, you would not think you were in Scotland, in spite of much similarity in the scenery of the two countries.

Next day the steamer crossed the Arctic Circle, and ran into the town of Bodö. A large coasting trade is carried on here in small sailing boats, which have remained almost unchanged in shape and rig since the days of the Vikings. They are long ships, rising both at the stem and stern so as to break the seas, but low in the waist—a survival of the old days when they were propelled by oars. The sail, then as now, is one square sail with a yard, with sometimes a small square top-sail, and in the stern there is a large projecting rudder. It is wonderful to think how much the Vikings did with such craft. They are doubtless good boats in such seas as are met with in the North Sea—they would not live long in the great Atlantic rollers; and the Vikings only raided in summer time, and drew their ships up in winter. But though these vessels might run before the wind, they would not do much even in the way of reaching, for they do not appear to have any head sail, and for the same reason beating to windward would be impos-

sible. We see ships like these embroidered on the Bayeux tapestry, and the Viking ship recently unearthed near Christiania was of the same type. These boats cannot compare in handiness or seaworthiness or beating to windward with a cutter; and the Vikings owed their success as pirates more to their own bravery, and the weakness of their enemies than to the superiority of their ships.

We left Bodö on the 6th of August for the celebrated Lofoden Islands and Hammerfest. The food on board began to show signs of our being far north. Raw smoked salmon, reindeer tongues and dried joints, bears' flesh and caviare of various kinds were all novel and characteristic dishes. Then there was the well-known *gamle ost*—old cheese—which is so strong-smelling that it has to be kept under a glass cover on the dining-room table, and various kinds of cranberries, cloudberries, and blaeberries.

The Lofoden Islands are in the heart of the cod fisheries which form the staple industry and chief source of profit in this part of the world. The harvest of the sea is far more valuable than the harvest of the land. The fish are far more numerous here, within the Arctic Circle, than farther south, and they are exported when dried to the Catholic countries of the Mediterranean. The Spaniards for some reason take klipfish or dried split fish almost exclusively; while the Italians seem to prefer the stockfish, or the cod that has been simply cleaned and dried. A very large resident population is supported on the islands, who live almost exclusively on fish, and it is reputed that

the women are exceptionally prolific. Ten or a dozen children is not an uncommon number, and as many as eighteen of a family is said to be on record. The cause of this extreme fertility is uncertain. Local repute assigns the source of fecundity to the almost exclusive fish diet; but fish diet is always lowering in other countries. A far more probable reason is found in the habits of life which lead to periodical absences of the male population.

The climate here is never severe; the fiords never freeze in winter, and even at the beginning of August, the thermometer stood at about 52° in the middle of the day.

The steamer crossed from the Lofoden Islands over to the large town of Tromsö, where she stayed nearly a whole day. There we were introduced to a very characteristic Norwegian institution—a whale-boiling establishment. No one who has not visited blubber-works can form a conception of the peculiar sickening odour which almost seems to thicken the air; and in this case the smell was intensified by the fact of the whale being at least fourteen days old, and therefore very high. However, in time people get accustomed to the smell, and the men who work at whale-boiling are very strong and healthy. The whole operation of cutting up a whale is done methodically. The animal is hauled up out of the water by a windlass, and then the blubber, or coating of oily fat that lines the inside of the skin, is cut off into slips with long knives, and finally boiled in great caldrons to extract the oil. Everything about

the place reeks of oil; the plank paths, and ladders are all slippery, and you cannot touch anything in the place without finding your fingers greasy and odorous.

It was a much more interesting excursion to a Lapp encampment on the mainland, for Tromsö itself is built on an island. After crossing a narrow sound and riding for about a couple of miles, we came to a collection of six huts on the sides of a valley. These huts, or rather tents, were conical or bell-shaped frameworks of poles, covered all round with reindeer skins instead of canvas, with the exception of a small hole at the top to let out the smoke. Men, women, children, and dogs lived promiscuously inside, and such little cooking as there was, also took place under cover of the tent. This, of course, is a necessity in such a cold climate. The Lapps themselves were extraordinary-looking people. Small, wizened, weird-looking men, with very poor limbs, and peculiar long turned-up noses very much pointed at the end.[1] Their hair was fair, but redder than the ordinary German flaxen locks; and their complexion light and of a curious pinkish red, perhaps from sun-burning. Their eyes were light gray, and the beard scanty, so that when dressed in skin coats and trousers one could readily understand why they were looked on as wizards and

[1] This feature of turned-up, bridgeless noses appears to be common among many Arctic nations, such as the Esquimeaux, etc. It has been suggested that a race with a Roman nose would suffer more severely from frostbite of that organ than the snub-nosed Lapp or Esquimeaux, so that the survival of the fittest would evolve turned-up, bridgeless noses.

uncanny by their Gothic conquerers. Both sexes were dressed almost alike, and as the head was always entirely covered by a tight-fitting skin cap the women could only be distinguished by their coats being longer than those of the men. Almost everything these strange people use is derived from the reindeer. Their clothes we have already mentioned, but even the needles are made from fragments of bone, and thread from the gut of the same animal. We bought some spoons, also of reindeer bone, and these were specially curious, for they had rude pictures of reindeer scratched on them, just as the same animal is represented on the relics of early man in the bone caves of the south of France. About 6 P.M. a herd of reindeer was driven down from the mountain where they had been feeding into a fold near the encampment. They came down in a mob, before some shouting boys and barking dogs, and seemed very docile and easily managed. I was surprised at their small size and slight strength. Nearly every man and woman has a coil of rope round their shoulders, and when they want to catch a reindeer they uncoil the rope, lasso the animal by throwing a loop over its horns, and then haul it in easily hand over hand. Every time one of the animals moves there is a curious cracking noise from the joints of the knees; and at this season of the year the horns were covered with fur. The Lapps picked a nasty-looking parasite about half an inch long, soft, gray, and caterpillar-like, from the skin of the deer. This animal burrows in the hide but does not seem to injure the

deer, and I believe that a somewhat similar growth on English cattle, known as "warbles," does nothing more than slightly reduce the value of the hide.

Our party left Tromsö at midnight, and found themselves the same evening at Hammerfest, the northernmost town in the world, where there is little at any time to detain the traveller on shore, and where it rained during most of our stay. However, at 10 P.M. on the 9th August I set to work to watch the midnight twilight. The sun was then very low, and, as it shone behind a small hill, illumined with a yellow glow the vaporous air between ourselves and some high ground to the north of the harbour. About an hour later, all that could be seen of sunset was a strip of pale yellowish sky along the northern horizon with some dark flat cloud overhead; but when the ship weighed anchor at midnight, there was still enough light to read easily. We soon got into more open sea, and then a yellow orb, apparently darker than the sky, rose slowly out of the sea, and soon disappeared under the canopy of cloud. At one in the morning the sky had scarcely changed, only there was a little more light generally; but by 3 A.M. the landscape had grown gray, and the clouds had descended to the level of the highest hill-tops. By six o'clock all was changed, for the sun was then breaking through the clouds and shedding a glare of light over the earth. Altogether there was nothing striking about the twilight, except the absence of darkness between the gloaming and the dawn. People sometimes complain of the want of night and of the

repose of darkness. Strangers would doubtless occasionally feel this, but the inhabitants do not seem to mind the perpetual day, and in fact prefer the constant light of summer to the constant darkness of the winter months. That the sun should appear darker than the surrounding sky is a point which has given rise to some controversy. Mr. Ruskin, among others, has denied that the sun which gives light to the sky, could be less bright than the product of its own power—the diffused brightness around itself. Theoretically it is somewhat difficult to suppose this, but as a matter of fact, the appearance is undoubtedly that of the ball of the sun being darker than the adjacent portion of the heavens.

It was too late in the year to see the sun at midnight, for now he disappeared nearly forty minutes below the horizon. Thousands of people go every year to Norway to see the midnight sun, and the remark they mostly make is that it is like any other sun. So, of course, it is; but it is strange for Englishmen to see the light in the north, and interesting to watch how much morning and evening there really is, by the waning and growing of the light, and by the rise and fall of the clouds.

Once the photographers thought that they had discovered something really peculiar about the midnight sun. A photograph of the sun, taken at midnight, made both the luminary himself, and part of his reflection on the water, come out quite black, instead of white, as it ought to do. This is reproduced in the accompanying photograph, where the curious black and

Plate V.

THE MIDNIGHT SUN.

portions of the sun's reflection, [illegible] round the black balls are w[illegible] was something out of the common [illegible] were made as to whether this was due [illegible] of a low sun.

It will [illegible] seen from this illustration, that [illegible] brilliant portion of the reflection is white, as it [illegible] would [illegible] be the case if the [illegible] colour, [illegible] and I have no doubt that [illegible] to which [illegible] call [illegible] exposed. [illegible] gelatine plates and [illegible] the action of [illegible] reverse [illegible] the [illegible] light [illegible] sun and higher [illegible] such [illegible] that the [illegible] result [illegible] where [illegible]

About [illegible] in [illegible] Cap[illegible] saw [illegible] of the sea [illegible] ground [illegible] but [illegible] surprise [illegible] and a [illegible] grass [illegible] at [illegible] [illegible] s'[illegible] slipper, and many other [illegible] in full blossom, though patches of [illegible] in the crannies of the rocks.

white portions of the sun's reflection, and also the small corona round the black ball, are well given. Here then was something out of the common, and speculations were made as to whether this was due to the crimson tint of a low sun.

It will be seen from this illustration, that the less brilliant portion of the reflection is white, as it ought to be, which would not be the case if the blackness was due to crimson colour, for then all the reflection would be black; and I have no doubt that the effect is due to what photographers call inversion by over-exposure. With certain gelatine plates, and with certain amounts of over-exposure, the action of the developer seems to be partially reversed, as the portions of the plate, where the high lights strike, are not blackened as they ought to be. In this photograph, the sun and highest lights were put into such a condition that the developer would not affect them, and the resulting print was black, instead of white, in these parts.

About seven in the morning we were abreast of North Cape, and saw an abrupt headland rising precipitously out of the sea to a height of about 900 feet. The ground behind is a barren plateau, as far as trees are concerned, but on landing we found to our surprise that the ground was carpeted with flowers and a little grass, but no moss. Blue forget-me-nots, red lychnis, buttercups and other *ranunculi*, yellow pansies, lady's slipper, and many other well-known plants, were in full blossom, though patches of snow lay unmelted in the crannies of the rocks.

Plate V.

THE MIDNIGHT SUN.

[illegible] of the [illegible]

[illegible] was [illegible]

[illegible]

, in the [illegible]

[illegible] seven [illegible] the [illegible]

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17th August, we saw the *Perseverance*, an English collier, discharging coals at the wharf, and immediately went on board to find out if she was going to the White Sea. It appeared that she was bound for the port of Soroka, near Onega, to load a cargo of deals, and that she was to sail next day. This exactly suited us, so we made a bargain with the captain to land us there. The next day was remarkable for extraordinarily high temperature. Here, several degrees within the Arctic Circle, one was so oppressed with the heat as to be glad to put ice into the beer at dinner. Of course Tromsö is much sheltered by mountains, but still one hardly expected to be distressed with heat so far north.

Our ship took the inside route from Tromsö, so as to pass south of the island on which North Cape is situated, dropped her pilot at Kelvig, and then went out into the open sea. In about thirty hours we were off Vardö again, and then running along the Lapland coast to the eastwards found ourselves in a new meteorological world. Hitherto the voyage had been wholly within the Atlantic system of weather and the influence of the Gulf Stream, but now we were in the true Arctic zone, where the harbours are closed for many months in winter, and where the courses of storms are very different from those on the west of Norway. There was, however, absolutely no obvious change in the appearance of the sky. On the morning of the day we were running past the mouth of the river Kola in Lapland, the sun grew pale and watery-looking, and some light drizzling rain set in, with a

south-west wind, and then in the afternoon the wind changed to north-west, and the sky gradually cleared into irregular flattish clouds, just as might have happened under similar circumstances in England. The vessel was generally just within sight of land, and one could see under the gloomy sky that the country was gradually getting flatter and flatter; while occasionally a few whales were passed spouting and gambolling in the water.

The *Perseverance* entered the White Sea on the morning of the third day after leaving Tromsö, and there could be no doubt as to the appropriateness of the epithet—White. The water churned up a brownish green under the propeller, and when at rest was pale and dirty-looking. The contrast between the blue of the deep sea, and the milky turbidness of this inland water would be even more noticeable in a sailing ship.

Next morning, 22d August, while approaching the anchorage of Soroka at half-speed, the ship suddenly jerked as something seemed to grate along her bottom. I was dressing down below at the time, and thought she had touched a mud-bank. But going on deck shortly afterwards it was evident that the accident was serious. There were already three inches of water in the fore-hold. The pumps did no good, and soon it was necessary to run the steamer ashore to prevent her foundering in deeper water. A comfortable-looking place was chosen, and an hour after striking she was put on the ground with 3 feet 6 inches of water in her hold.

Luckily the weather was perfectly calm, for the water soon rose inside her to the level of the sea. This was a very unfortunate occurrence, for there are absolutely no appliances in the White Sea for mending or pumping an iron steamer. She was got off two days later, and kept afloat by turning the main engines ahead to utilise the bilge injectors, but I have never been able to learn how she has fared since.

CHAPTER XI

ARCHANGEL: THE AURORA BOREALIS

Soroka is a small town at the mouth of a river of the same name, and the *raison d'être* of its existence is a large wood-cutting establishment which belongs to an Anglo-Russian firm. The anchorage is beyond the bar, nearly five miles from the town, and the shallow branches of the stream are covered with stake nets for catching salmon.

The aspect of the country differed from anything we had seen before in this part of the world. All the ground was flat, with rounded granite rocks projecting here and there, and covered everywhere with a forest of small pine-trees. We were now just outside the Arctic Circle again, and within the northern limits of tree life, but still the stems were all small, and the trunks we saw lying in the timber-yards had been floated down the river from farther south.

The town is built on several islands, and along the banks of two streams that unite there. The houses are irregular log-huts, with rather wide grass-grown streets between. Dilapidated plank-walks run down the middle of the streets to serve as pave-

ment, and in wet weather the rest of the street must be a sea of mud.

The men were just like the typical pictures one sees in England of Russian peasants—large men, with rough hair and beards, wearing coarse gray jackets, and baggy trousers tucked into big knee-boots. The women were also large, and had usually pleasant faces, but their general appearance and gait showed that they were chiefly employed as useful animals. They wore an ordinary petticoat and loose body, with very high waists, and when working the petticoat was tucked up to the knees over a belt round the outside of the waist. Their legs were mostly bare, or else they wore long knee-boots drawn over stockingless feet. Of course this was an excellent costume for working, but the effect was inelegant, as the women looked like mere bundles of clothes.

Almost all the boats were rowed by women. The post boat required six, the telegraph boat four women, with an odd one to steer in either case. These were rather more picturesquely dressed in short blue petticoats and coarse reddish stockings, but they rowed slowly. The pay is only 10 roubles—£1—a month; and perhaps one cannot expect much work for that money. If a boat is to be tracked up a river the woman hauls on the rope—much the hardest work—while the man keeps the boat off the rocks with a long pole.

Soroka could not boast of anything in the way of a hotel, but we were comfortably put up by a ship's chandler, who knew two or three words of English.

On a table in the public room a box of tobacco and some empty cigarette cases were always lying. Visitors filled a case for themselves, plugged an end with a morsel of cotton wool, and then the smoke began. Close by stood also a bottle of *vodki*, some glasses, and some biscuits. The former is never drunk by the Russians without taking a mouthful of the latter.

Vodki is the national beverage of the Russians. The spirit is distilled from rye, and I think far preferable in flavour to whisky made either out of barley in Scotland, or out of Indian corn in the United States. There is a delicate ethereal aroma about *vodki* that no other spirit can rival. It is weak, but very pure, as there are stringent government regulations against adulteration; and the Russians declare that however drunk you get on *vodki* overnight, you will not have a headache in the morning. This is probably hardly absolutely true, but there is no doubt that, as spirits go, this one is wholesome. Intoxication brings out a curious phase of the national character. When Russians are drunk they become affectionate, and not quarrelsome. One sees two men rolling on the ground, hugging and kissing one another, when Irishmen would have been fighting with their shillelags. There seems to be a clannishness about the Muscovites, while the Hibernians are always ready to roast one another, so that we have here only a new illustration of the truth of the old saying, "*e vino veritas.*"

Another characteristic Russian institution was also never far off in the *samovar*, or urn for boiling the water

to make tea. This is something on the principle of our old-fashioned urns, in which the water was kept hot by dropping a red-hot piece of iron into a chamber inside the vessel surrounded by water; only in the *samovar* this hot iron cylinder is replaced by a pipe going up the centre of the urn, filled with burning charcoal. There are arrangements by which the draught can be increased, and the fuel made to burn up quickly when required, and altogether the *samovar* is a most useful and efficient tea-kettle.

The religious feeling of the Russians is very strangely marked by the presence in every room of a sacred image or *obraz*, the Greek *eikon*. This is usually a Madonna and child; but by a strange conventionality of the Eastern Church the flesh parts—face, hands, feet, etc.—are painted, while the drapery and surroundings are of brass or other metal. Even a business office has its *obraz*, usually in an angle of the room; and it seems strange to us to see a man come into a *bureau*, kneel, and cross himself before the figure, and then go up to the counter to transact his business. The Russians really believe in some influence due to these images. During the retreat from Moscow there were cases in which the peasants took a captured Frenchman into a room, and then turned the faces of the images to the wall before flaying the prisoner alive.

Another curious piece of furniture in every office is a framework of wires, strung through beads for calculating upon. This is the old *abacus* of the Romans, and all accounts, wages, etc., are practically

calculated by this means. A clerk sends the beads about faster than one can see, and gets his sum done very quickly, though the result is sometimes wrong. The instrument did very well when caligraphy was difficult, and writing material awkward or expensive; but now in the days when pens, ink, and paper are all cheap, a written account is far better, as the figures can be checked. When clerks were few in number, figures were awkward, and calculations had to be made with a style on a waxed tablet, or on a slab of soft clay, or with thick oily ink on valuable parchment, then the beads were both a useful and a time-saving appliance.

We started for the White Sea with the intention of going up the Dwina from Archangel to about Vologda, and then travelling by rail to St. Petersburg, and so home. At Soroka we heard that route was impossible. The river is so low in August that steamers cannot get half-way to Vologda, and the only practicable journey at this season is by a half-open post boat in twenty-four hours to a little place called Soumski, then 150 miles in a *tarantass* to Povienski on Lake Onega, whence by steamer in three days to St. Petersburg. There are no inns on the road, only empty post-houses; food and bedding must be carried by the traveller, and the *tarantass* changed at every station. This would have been so uncomfortable for those like ourselves who did not know a word of the language, that we determined to give up this project and go home by a direct steamer from Archangel.

Two days after our arrival at Soroka, a small local steamer came in and took us in about two days to Archangel, thus affording us an opportunity of visiting the celebrated monastery of Solivietz or Solivetski. A row of four miles from the town to the steamer at her anchorage, and then a run of eight hours, took us to a little inlet at the mouth of the river Kem. Here the boat remained twelve hours till mails could be exchanged with a small town of the same name some miles up the river, and then started for Solivetski.

In about twenty-seven hours we came in sight of some low wooded islands covered with large irregular buildings, their huge Oriental domes projecting like inverted balloons above the trees. The passage between the rocks was very intricate, while the ecclesiastical spirit of the place was indicated by the crosses which marked every buoy or beacon. The first thing which struck us was the immense number of huge, gray, tame seagulls, which swarmed on the pier and in the waters of the harbour. There were also some very tame pigeons. These birds are never killed in Russia, because the Holy Ghost once appeared in the form of a dove.

The general aspect of the buildings is not imposing. They lack unity of plan, or any good point of view. Lines of irregular houses formed quadrangles and courtyards, all set crooked to one another, and there was no fine masonry to palliate the defects of design.

But the glory of Solivetski is the chapel. This is

a square building with four great square pillars inside to support the roof, and numerous side chapels or shrines. The outside has no pretensions to architectural beauty, but the inside is gorgeous. The whole is gilt except the panels for pictures and *obraz.* The former were mostly very bad—the best were not more than moderately good; but the latter were very striking and most distinctively Russian. A great plaque of gilt brass or silver, partly embossed, partly chased, was fixed into an upright wooden panel on the wall. This represented drapery, the corona round the saint's head, the background, or anything that was not flesh. The flesh portions of the picture were cut bodily out of the metal, and the faces, hands, feet, etc., painted underneath on the supporting woodwork. The pilgrims come here in hundreds, cross and prostrate themselves before these figures, then kiss them, and perhaps hold up their babies to do the same. Some also light tapers, which they buy in the monastery, and burn them in places for the purpose in front of the images.

We heard part of a grand service which was decidedly impressive. The archimandrite stood near the entrance to the church, facing the altar, clad in gorgeous vestments, with a long candle in his hand. Seven monks on either side—also with lights in their hands—lined the way up to the altar. A somewhat complicated ceremonial followed, while the service was sung to Gregorian music without any instrumental accompaniment. One could not but notice a certain slovenliness about everything. The monks were dirty

in their person, ill-finished pictures covered the walls, the music was badly copied, and there was no look of energy or vigour in the men. In fact the monks are decidedly an ill-looking lot, with bad drawn eyes, long hair, and long dirty cloaks. Still Solivetski is one of the most popular places of pilgrimage in Russia. The monks keep one or two steamers to bring pilgrims from Archangel for three roubles (nine shillings) a head; but then the visitors are lodged and entertained free of charge for three days by the monastery before being taken back. There is a large building close to the landing-place, which is used as a hotel for men and women.

Pilgrimages had a bad reputation in England even when Chaucer wrote his famous *Canterbury Pilgrimage*, and a pilgrimage in Russia appears to partake very much of the same character as its western equivalent. Many pilgrims are actuated by the purest religious enthusiasm; but there are many immoral episodes in every pilgrimage. There was a Russian naval officer on board our steamer going, as he himself said, to enjoy a pilgrimage and pilgrims. He had just come from St. Petersburg, and had met *en route* at Povienski a lady on her way to Archangel. She was plump and about thirty-two years of age, but had been mad during the winter. Then she had tried to hang herself in a fit of despondency, but was now apparently well. The engineer was very attentive to her, and they got out together at the monastery to await the arrival of the next steamer in about ten days' time. It is rumoured that the conduct of the

monks towards some of the female pilgrims is not always as it ought to be.

This monastery was bombarded by an English fleet during the Russian war of 1853-55; but it is difficult to conceive a more senseless proceeding. The ships appear simply to have sent a certain number of shot and shell into the buildings and then to have gone away. The monks show you now with pride a pile of old shot lying in one of the quadrangles, and even one or two missiles still sticking in the walls, and say that the English could do nothing. If our men had landed they might have secured a moderate loot. There are some silver candelabra and other utensils which would have been valuable, and probably some money could have been discovered; but the fleet did nothing except waste a certain amount of powder and shot without doing any appreciable damage to our enemies.

The steamer left Solivetski on the 25th of August, and a short run of twenty-four hours against a head-wind brought her to the town of Archangel, a few miles up the river Dwina. The country there is flat and uninteresting, but covered in most places with small pine-trees. The town is picturesque from a distance, owing to the numerous spires of Greek type belonging to the cathedral and other churches. A nearer view, however, shows that the streets are ill kept, the pavements bad, and the shops poor. Archangel used to be one of the great ports of the Russian Empire, where a flourishing English colony did a large business in hemp, wood, tallow, etc. But now, since

the railway system makes it easier to send produce to St. Petersburg or Riga, than to send it down the Dwina, Archangel is rapidly decaying, and all the British merchants have left the place. A small handful of Germans are still trying to subsist on the little business that is left, but they are not doing well. There is but one English firm now left in the White Sea, which has a large lumber mill at Onega, where it employs only two Englishmen—a manager and an engineer.

There is no decent hotel in the place, but we were put up at the German Club, and hospitably entertained by the British acting consul, Mr. Gellerman, at Solombol. The latter place is about three miles down the river from Archangel, and is to a certain degree the port of the latter. The ocean steamers lie off Solombol to take in part of their cargo, and then go over the bar of the river to load the remainder.

Mr. Gellerman has resided all his life in Russia, and gave us a very interesting account of the position of the Russian peasant. The Muscovite is in some points much better off, in others much less favoured, than the English countryman. Ivanhoff can neither starve nor be evicted from his dwelling; while Hodge may die by the roadside unless he consents to part from his family, and enter the semi-prison of the workhouse. As existence, and family ties are the first conditions of society, our very poor are worse off than the Russians. But in every other way our people are in an immeasurably better position. Russian judges are usually upright, but the police are radically corrupt,

and live on blackmail. The peasant is a communistic democrat in all that concerns his own village, but a child in all political matters that affect the empire. He has no vote, no parliament, no right of speech, no free press, and very little power of education, in fact nothing that every Englishman considers his birthright. As a result he is a happy, coarse, dishonest man who has no power of rising beyond his present position.

There is little of interest in the neighbourhood of Archangel; but a visit to an encampment of Samoyedes introduced us to a totally different race to any we had met before. These were degraded specimens of the race who had given up their nomadic life to loaf on the outskirts of the town. They lived in conical skin huts, dressed in their deer-skin clothes, and subsisted on the entrails of animals which they begged from the slaughter-houses. The faces of the Samoyedes are undoubtedly Mongolian, with high cheek-bones and oblique eyes, and their language has certain affinities with the Finnish. Some travellers think that the Lapps have a slight Mongolian expression, but we could never detect that likeness.

We left Archangel on the 29th of August for Hull, on board an English steamer that had brought out coals to Norway, and was taking home a cargo of sawn wood from Russia. When fully loaded, the deals were piled up ten feet above the deck forward, and eight feet aft. Passages were left through a sort of tunnel by which to descend into the cabin and forecastle; but though this seems dangerous, sawn wood is really one

of the safest of cargoes. The high centre of gravity makes the ship very easy, and the whole deck-load can be sent overboard with the greatest ease in case of emergency. The antithesis of wood is pig-iron, which forms the most dangerous cargo a ship can take on board.

After travelling in some of the finest liners afloat, it was painful to see how badly a British steamer may be managed. Our horse-power was nominally 110, but this had been arbitrarily written down to 99. By this means a second-class certificated engineer could be shipped, and so a pound or two per month in wages saved. Then the navigation was very rough. The mate took one sight of the sun in the morning, and then walked off the bridge into the chart-room to look at the chronometer. The captain had a master's certificate, but could not find the compass error from an observation on the sun without the use of Burwood's tables; so as these are only calculated up to 60° north latitude, we could not find our compass error till we were past Bergen, and nearly home. As a necessary consequence our course was rather wild. Though the weather was fine throughout, the ship was one day more than forty miles out of her computed place, and another time she was found steering two points—22.5°—north of her expected course. A passenger on board gave us some very amusing accounts of the erratic routes taken by some of these White Sea boats. Once he left Hull for the North Cape, but found himself soon off Dunnet Head on the north-west of Scotland; while on one occasion another steamer starting for the same destin-

ation actually found herself off the coast of Iceland. These were disgraceful cases of bad navigation, but there was a little excuse for our own, as the variation of the compass changes from about 5° east at Archangel, to 5° west, in the short distance between that town and the North Cape.

The voyage was quite uneventful, but some interesting phenomena of the sky were observed. We steamed up the White Sea against a north-north-east wind, with a few drops of rain at intervals. Towards evening the weather cleared and the sky was covered with small detached cumulus, exactly the same as we have described in a previous chapter as being characteristic of the trade winds. If one had been suddenly dropped down here from a balloon, we could not have told by the shape of the clouds and direction of the wind alone, whether we were in the Tropics or the Arctic Circle; but a glance at the surroundings would have enabled us to form a fair judgment of our whereabouts. In the first place, the temperature and comparatively small amount of vapour in the air, would at once have suggested northern latitudes; then the wind had not the steady blow of the trades, and there was a whiteness about the blue of the sky that does not belong to the Tropics. If any land had been visible, there would probably have been a certain amount of refraction in the Arctic Circle, which is absent near the Equator; and any vegetation would, of course, have told its own story of a warm, a temperate, or a frigid climate.

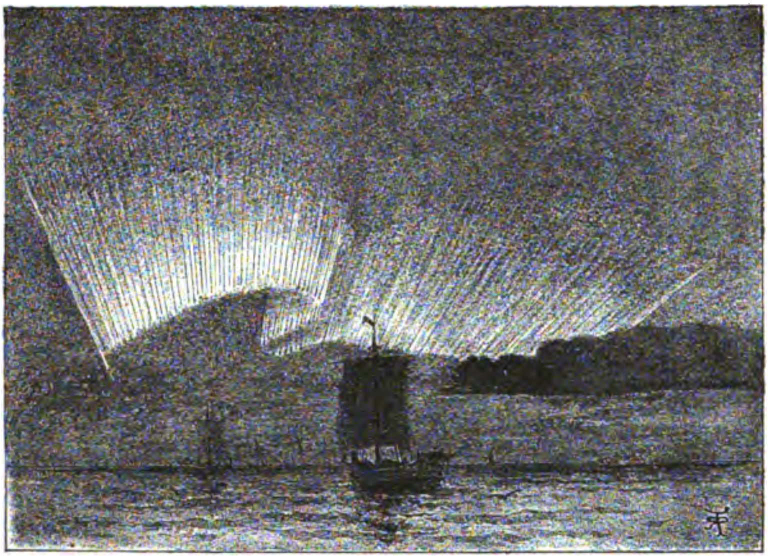
The White Sea is quite within the Arctic system

of weather, as opposed to that of the Atlantic, but both going and coming we found no sudden contrast of weather, or of the appearance of the sky, such as one finds in running into the trades, or out of the doldrums. I fancy that in winter the transition would be somewhat strongly marked.

After rounding the North Cape the vessel kept outside the Norwegian islands on her way south. Off the Lofodens, on the 3d September, the weather was so fine and warm that one could sit reading on deck all day, although well within the Arctic Circle. The same night, about 2 A.M., there was a magnificent auroral display, of a type that is almost unknown in England.

The morning twilight of an Arctic night was glowing to the right of the northern horizon, and a clear waning moon was shining in the east. Between them lay a low bank of hard flat cloud, while overhead floated the thinnest film of condensed vapour, too structureless to be called cirrus, but yet at times sufficiently dense to form the faintest corona round the moon. The ship was rolling slowly, and though the wind blew lightly from the east, the highest cloud-drift was passing rather rapidly from west-north-west. Then suddenly a curtain of light appeared in the northern sky, somewhat as in the accompanying sketch. If one called the whole a curtain of light, and the converging streaks the streamers, one might say that while the streamers flickered independently up and down in the direction of their length, the curtain appeared to sway about like a piece of drapery. The

streamers did not form a regular arc, as one so often sees in England, but the whole set formed a regular folded curtain. The point towards which they all converged was far below the horizon, and this proved that they themselves were individually all inclined to the horizon, no doubt at the same angle as a dipping



AURORA IN THE ARCTIC CIRCLE.

magnetic needle. There was no trace of colour in this aurora, but the silent play of the cold light, in the middle of the night, was a strange manifestation of the hidden forces of nature.

Modern research has done little to explain the real nature of the aurora. Some measurements would place the aurora 120 miles or more above the earth, while others would bring the level down to a few thousand feet. Lockyer has made the important

discovery that a certain green line in the spectrum of the aurora, which belongs to no terrestrial substance, is found in the spectrum of meteorites when an electric discharge is passed through them, but this line of research is still in its infancy. On this night certainly, the flickering of the folds of light appeared to be connected with the drift of filmy ice or water particles in the highest layer of cloud, and these were probably not more than 20,000 to 25,000 feet above the sea. We do know however, as a matter of fact, that there is a belt or zone round the world, roughly about the Arctic Circle, in which auroras are exceptionally frequent; and we also know that there is another zone round the world in the doldrums, near the Equator, where thunder and lightning are more or less prevalent both night and day; but whether these two different forms of electrical discharge have anything to do with one another we cannot say. Neither the noisy discharge of electricity, nor the quiet glow of sheet lightning affect the compass, while the silent play of the aurora usually deflects the magnetic needle. The secret of the aurora has yet to be discovered.

Nothing more of the slightest interest was seen during the voyage, and on the twelfth day after leaving Archangel we ran into the Humber, and our trip to the Arctic Circle was at an end.

CHAPTER XII

TO THE CAPE OF GOOD HOPE: DIAMONDS

THE experience gained in our former voyages, enabled us to start for another long journey with a much more systematic programme, and with better instrumental appliances. We had three special objects in view for this trip, and they entirely dictated the course of the voyage.

The first was to visit some hurricane countries, and, even if we were not fortunate enough to experience a tropical cyclone, to gather, at all events, by personal conversation with those whose special business it was to observe such storms, the information on certain details which was necessary for working out the relation between tropical and extra-tropical weather.

The next object was to continue the observation and photography of cloud forms in different countries; and thirdly, to watch very carefully the march of the higher clouds over the calm doldrums near the Equator. Our former observations had thrown an entirely new light on the subject, and we wished to develop the matter still further. In addition to

these primary objects, we hoped to learn much as to the nature of ordinary day-to-day weather in the Tropics, and to see the organisation of the different meteorological offices in the countries we passed through, with special reference to their weather forecasting departments.

The journey was entirely successful as regards the two first objects, but though we got some very good observations near the Equator, we found that a great many more will be necessary before the object of making them — the discovery and nature of the general circulation of the atmosphere at the meeting of the trades—can be attained.

I knew that, leaving England in November, we should arrive in Mauritius in the height of the hurricane season, so a few minutes after noon on the 27th of November 1885 we sailed from the pretty little inlet of Dartmouth for the Cape of Good Hope in the fine steamship *Drummond Castle.* The wind, after a squally night, had turned towards the north-west, and soft fleecy clouds flew fast over the Devonshire hills; but on clearing the mouth of the harbour we saw a dark hazy bank of gloomy mist on the south-western horizon, and by nightfall the ship was driving into a strong south-westerly wind, with a rough uneasy sea.

The next two days found us traversing the Bay of Biscay in weather truly typical of that well-known region, viz. a moderate gale from the south-west, occasionally rising into ill-defined squalls; a uniformly dull low sky, with spindrift flying in wreaths along the

tops of the waves, and filling the air so full of vapour that it was impossible to say whether it was raining or not. The sea was irregular, not exactly lumpy, but very different from the long regular waves which sweep round Cape Horn. The crests were so ill defined that it was impossible to measure the rate at which the waves travelled, but no two crests were ever so far apart as the length of the ship—some 400 feet. By slowing the vessel down to six knots, she took the seas easily, with nothing but clouds of spray driving aft from her bows, and the top of a wave occasionally splashing up on to the lower quarter-deck; but walking was difficult, and in spite of her weatherly qualities, 90 per cent of her passengers were confined to their cabins.

It is in weather such as this that one finds the advantage of a long ship. A short old-fashioned boat pitches into an advancing wave, and is brought up suddenly with a shock which is popularly known as "pile driving." The jerk is often sufficient to toss a man out of his berth, and to start things from their lashings, besides adding greatly to the discomfort of a voyage. So much is pitching modified in a long modern vessel, that the old governors for the engines, which depended on the pitch of the ship for their action, cannot now be used. In a long ship, while the trough of one wave may leave the screw nearly out of water, the crest of another may be lifting her bow. As usual, fresh difficulties only stimulate to improved invention, and the pneumatic governor now in use is far superior to any of the

older regulators. In this ingenious contrivance, the varying depth of water over the screw is used to compress and expand the air in an iron bell, and the partial vacuum caused when the trough of a wave leaves the screw uncovered, sucks in a trigger which stops the engine before it can race round at a dangerous speed.

The more one sees the value of modern appliances, the more one realises the frightful strain which the blockade of Brest entailed on the British navy in the wars at the commencement of this century. On one occasion, Admiral Lord St. Vincent kept his fleet for nine months on end in the Bay of Biscay blockading Brest. The ships were mostly short seventy-four gun frigates, which rolled heavily and took in a good deal of water. There was no fresh condensed water, no new bread every morning, no fresh tinned or frozen meat, or preserved vegetables in those days. Nothing but water, which was often nearly putrid from standing for months in a dirty cask; dry ship biscuit, creeping with weevils—a kind of beetle;—salt beef alternating with salt pork, and no vegetables of any kind. Added to the low health which diet of this kind must produce, there was the peculiar irritation which arises from constant exposure to weather and dirty clothing. Can we wonder that under such a system many died of scurvy, and that a few irritable temperaments were driven by desperation to commit acts of mutiny and insubordination?

The weather improved as soon as Cape Finisterre was passed, for the sky got higher and the wind and

sea went down, till the *Drummond Castle* steamed up the Tagus into Lisbon against a light north-east wind with a hazy atmosphere.

The ship only stayed eight hours at Lisbon, so I landed at once to call on Signor Yvens Capello, the eminent meteorologist and director of the observatory of Dom Luiz, who issues the weather forecasts for the Portuguese Government. He received me very courteously, and showed me over the observatory, pointing out the most interesting instruments. Among them were some which his brother, the explorer, had taken across Africa. He also showed some of their daily weather charts, and explained some of the peculiarities of Portuguese weather and cyclone motion. The most interesting charts of course were those that explained the weather which we had experienced in the Bay of Biscay. A cyclone coming in from the Atlantic and remaining almost stationary, so that the ship had a steady south-west gale and rain, without much shift of wind, till she had sailed southward, out of the influence of that disturbance. This, as was shown in a former chapter—"To Egypt"—is one of the commonest types of weather in the stormy bay.

At 3 P.M. the ship steamed out of the Tagus on her way to Cape Town. For two days we carried a light, hazy north-east wind with us, known as the "Portuguese Trade"—an extension of the true trade wind far beyond the limits of the Tropics—but meteorologically identical with it. Then, shortly before arriving abreast of the Canary Islands, we met the true north-east trade wind, before which the

vessel ran for six days till she reached the latitude of 5° north of the Equator. This part of the voyage was externally most gloomy and monotonous. A peculiar dust haze seemed to fill the air and to take the brilliancy out of everything. The clouds looked soft, the sea appeared dull, while even the sun had no glare, and rose and set among pale gray tints. One day when near the African coast we found a grasshopper, a wasp, and a butterfly going out towards Cape Verde Islands, and doubtless numerous other waifs from land would have been discovered if they had been specially looked for.

The same curious sky was present here as that described in our former voyage home from Rio Janeiro. Whichever way you looked you saw a series of cloud bars parallel to the horizon, like the bars of a Venetian blind, while overhead there was nothing but a few thin irregular flakes of cloud floating in the pale blue hazy sky. On the fifth day out we were near Cape Blanco on the African coast, and only about 20° north of the Line. The morning was singularly chilly, and a very heavy dew had fallen during the night. Half an hour before noon the thermometer on deck only marked 69°; and at the same time I not only observed a peculiar iridescence of the clouds which is only formed by icy particles, but also the familiar halo, of about 22° diameter round the sun, which is an unfailing evidence of icy spicules floating in the air. It is a curious thing to find cold and dew so near a burning continent, for the surface wind was off-shore from north-north-east

though the clouds drove from about south-west. I had a talk with our commander, Captain Jeffries, on the subject. He informed me that he always found it cold here, and especially so in summer when the neighbouring desert was hottest. Also that a perfectly analogous cold and dew were found in a corresponding latitude south of the Equator, off Cape Frio (Cold Cape in Portuguese), near Walfish Bay. A very similar phenomenon is found off Cape Gardafui, on the opposite side of the continent. There a cold, fog-producing current appears unexpectedly, when the south-west monsoon blows off-shore. This constitutes a danger and also a safeguard to ships. A danger on account of the fog; a safeguard, because the fall of temperature in the sea is a warning of the proximity to land. The modern explanation of the cold off Capes Blanco and Gardafui is that the off-shore wind blows the surface skin, as it were, off the sea, and that then cold water from below wells up to restore the natural level. We have in fact a cold vertical rising current, instead of a cold lateral current like that Arctic stream which flows down the coasts of Labrador.

The following day Cape Verde, with the pestilential French settlement of Goree, were sighted; and then, saying good-bye to land for a fortnight, we made a straight course to Cape Town. The north-east wind, which had blown persistently since leaving Lisbon, now began to fall very light; the temperature of the sea rose to 80°, the sky grew more dull, and the air closer and hotter. On the morning of the 8th

December the sun rose on a soft, dull, gray, uniform layer of stratus, hardly forming a true cloud, with a faint air from north-north-east. By 11 A.M. even this failed, and the ship steamed through an absolutely calm sea, on the oily surface of which a long high swell rolled in from the southwards, while an occasional faint cat's-paw of wind only intensified the general smoothness of the water. The air grew increasingly close and hot: at 11.30 A.M. the thermometer on deck marked 86° and the sea water was only a little less at 83°. All round there was a universal gray steamy haze. Overhead lay an almost uniform sombre canopy of formless condensed vapour, in which at rare intervals a faint trace of ill-defined cirro-stratus cloud could just be distinguished moving very slowly from the eastward. When the sun sometimes shone faintly through the dark pall, it was only to show a hazy disc, not so much blurred as in what we call at home a "watery sky," but more indistinct than when seen through a morning mist. This lasted for three hours. At 2 P.M. a fresh, comparatively cool breeze sprang up from about south-west, followed soon by a pretty heavy shower; then the sky grew higher and more compact, though all was still soft and misty. During the night a few stars could be seen dimly overhead through the haze, and sheet lightning played all round the horizon. By six o'clock next morning we woke to find ourselves in a new climate;—a brisk south-westerly breeze, with a crisp curling sea; a bright blue sky, in which small detached cumulus of

the true trade wind type scudded before a southerly wind; everything bright and clear and pleasant, though the air was still hot and the thermometer marked 82° on the upper deck.

Such was our passage through the doldrums—that dreaded belt of calms in which formerly ships often lay for weeks together, sometimes rolling their masts out, and causing great discomfort on board. It may be noticed here how much narrower the calm belt was at this season near the African coast, than in mid-Atlantic in July. Allowing for the slant of our course the width was about thirty miles now, as against four hundred on our voyage home from New Zealand. The origin of this calm belt has long been known to be due to the meeting of the two trade winds, but there has been a great difference of opinion as to the nature of the general circulation of the atmosphere over these calms. Some meteorologists have asserted that the air rose over the calm belt and then doubled back over the hemisphere from which it came; others have maintained that the north-east trade managed to rise over the south-east trade and descended to the earth's surface as a north-west wind outside the southern Tropic; while the south-east trade mounted over the north-east trade and descended to the earth as a south-west wind in temperate northern latitudes. As has just been mentioned, one of the chief objects of our voyage was to try and settle this question by watching the direction of the different layers of cloud, so that we were very busy during these two days, and fortunately succeeded in getting some very valuable

observations, the results of which are given in Appendix II.

For a day and a half after crossing the doldrums the same fine weather and south-south-west wind prevailed—the so-called south-west monsoon of the Gulf of Guinea. After crossing the Line, the wind backed to south-east, and remained in that quarter till we got to Cape Town. The sky was always more

CLOUDS FLOATING ACTUALLY OVER THE EQUATOR.

or less clouded near the Equator, mostly with small trade cumulus, leaning forwards from the north-east; replaced farther south by thin flaky stratus, which looked like a venetian blind on the horizon.

I was very anxious to take a photograph of a cloud actually hovering over the Equator, and by calculating that our position was there at a particular hour, obtained the picture here reproduced, where a typical patch of trade cumulus appears near the horizon, and patches of degraded cloud higher up in

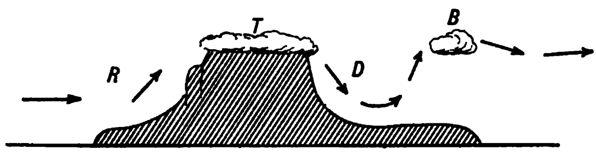
the sky. As a rule the sunsets were poor, and the sunrises still less brilliant. We only saw two sunsets, in about 10°-15° south, which were worth noticing. In both of these a second purple light and after-glow were very prominent. After one of these I noticed an effect of the setting of Venus which I had never noticed before. Shortly before the planet set, its light died out, and flashed up again, for nearly ten minutes, like an intermittent lighthouse. Sometimes the flashes were red, which still further increased the illusion. This was doubtless due to the varying refraction caused by the motion of masses of air of unequal temperature or moisture.

On the 15th December we passed under the sun. Every day since crossing the doldrums the air had got steadily cooler, and this continued till the ship arrived at Cape Town. This shows how many other causes are necessary to make hot weather than merely proximity to the sun.

On the afternoon of the 18th December Table Mountain was sighted, and in a few hours the ship was along the dock quay of Cape Town. It was so cool and pleasant on the water that one could scarcely realise what was told about the heat ashore. But the stratus cloud which covered the sea seemed to stop a few miles off the land, and to leave fringing the coast a belt of blue sky, from which poured down the fiercest sunshine I have ever experienced. Though three weeks at sea the passengers were all burnt brown in a quarter of an hour, and the effect was so great as to be noticed by everybody.

The situation of Cape Town is picturesque. A semicircular basin faces the north-west; to the north and east, the steep rugged cliffs of flat-topped Table Mountain domineer over the city; to the southward, a low ridge, terminating in a hillock known as the Lion's Rump, completes the bay.

As we saw it, when in the cool night air the mountain top shone in bright moonlight, and lovely flecks of fleecy cloud flew swiftly across the starry sky; or when, in the early morning, a light ground-mist encircled the mountain like a collar as the vapour



"TABLE-CLOTH" AND CLOUD-BAR OVER CAPE TOWN.

lifted before the rays of the rising sun, Table Mountain presented itself in its mild and beautiful aspect.

Very different is it when a strong south-easter, rising from Simon's Bay on the other side of the mountain, spreads a table-cloth of white cloud on the summit, and then pouring violently down the steep cliffs, drives dust and gravel through the streets of Cape Town, and finally rebounding upwards forms a bar of cloud detached from the mountain but parallel to it. The town is then almost impassable, for not only dust but quite large stones are blown about by the violence of the wind coming down from above. The engraving is adapted from Sir J. Herschell's diagram of this curious cloud-bar. The south-east wind rises at R,

condenses its vapour into a white table-cloth of cloud, T, on the top of the mountain, rushes down into the town at D, then ricochets up and forms a cloud-bar at B.

A very similar cloud is formed over Crossfell in Cumberland, and the wind in the same way jumps up and forms a bar of cloud parallel to the main chain of mountains.

Among the convicts who were working at an extension of the dock it was pitiful to see some gangs of white men. They were nearly all convicted of illicit diamond-buying, to prevent which, very stringent special laws have been passed. One of the largest legitimate dealers in diamonds at Kimberley gave me some information about the trade. The whole of the diamonds are found in four mines. At present these are worked at great disadvantage by numerous companies, some very small, and deficient in capital for economical working. Efforts are now being made to consolidate all these mines in the hands of one company, which with a capital of about £10,000,000 could be brought out in Europe. This company would then control not only the mining but also the market for diamonds. Recently the average price per carat of all the stones produced has been only fourteen shillings, though in individual stones the price may vary from five shillings a carat for bort or amorphous diamond, to £25 or more for a large pure-water stone. At the mines, the stones are sold every day by some companies, or once a week by others. The dealer assesses them and pays cash down. The stones are

then sorted, sent to London in registered letters, and sold at once. My friend told me he could assess diamonds within three per cent of what they could fetch in London, and that his firm were satisfied with a profit of five per cent as they turned their money over so quickly. The finest diamond in the world is the English Koh-i-nor; the French, Austrian, and Russian crown diamonds, though larger, are either of bad water or flawed. A syndicate of capitalists in London is now working a still finer one. It came from Kimberley, no one knows how, though of course it was stolen by an *employé* in the mines. It was bought for £19,000, and the best diamond cutter in Amsterdam has contracted to cut it in a year for £1100. Some men offered to cut it for £700, but the owners thought it better to employ the most skilful man they could find. An ordinary stone takes a fortnight to cut, but a man works six or eight at a time.

On the average, a rough diamond loses half its weight when cut into a brilliant; but, in spite of this, the new great stone will weigh about 162 carats, and will not cost less than £50,000.

CHAPTER XIII

TO MAURITIUS : HURRICANES

After a stay of only eighteen hours in Cape Town we embarked on board the *Taymouth Castle* for Mauritius, and at four o'clock in the afternoon were abreast of the famous Cape of Good Hope. The long promontory which divides Table Bay from Simon's Bay here runs into the sea as a sharp narrow ridge of rock. Perched on the crest of this, about 200 feet above the sea, stands Cape Point lighthouse, behind which rise the dry and rugged hills which form the promontory. We saw it bathed in bright sunshine with a foreground of dancing sea; but the confused cloud which rested on and above the hills suggested sufficiently that it was not always fine weather near this dangerous headland.

Next day found us in a different climate, with irregular cumulus flying before a fresh westerly breeze, over a white crisp sea with a heavy north-westerly swell; while a cool invigorating air formed a pleasant contrast to the hot disagreeable south-east trade in which we had been sailing for the last ten days.

The four following days we coasted along the

shores of South Africa, calling at the principal ports, such as Port Elizabeth, East London, and Durban. A heavy swell always prevails on this coast, and as there is no harbour which a large steamer can enter, passengers and mails are sent over the side of the ship in a big wicker basket. At one place this was cylindrical, with a door at the side so that ladies could get in and out comfortably; but at others there was only a sort of washing basket, in which two people could just be stowed. This was put under the crane, hoisted off the deck, swung over the side, and then let down on the deck of the tender as gently as the motion of the sea and the skill of the winch man would allow.

Our bright cool weather scarcely lasted two days, and from off the Kaffrarian coast till the southern shore of Madagascar was sighted, three days after leaving Durban, we experienced nothing but moderate east and south-east winds, with a dull hazy sky, producing a damp clammy feeling about everything. I have very little doubt that this was the effect of the hot Agulhas current, which runs down from the Equator, between Madagascar and the African coast, and then skirts the shores of the Cape Colony nearly as far as Cape Town itself. As soon as we were well under Madagascar the horizon grew clear, and a south-east wind raised a crisp curl on the surface of the heavy swell which constantly runs in this region.

The aspect of Madagascar as seen from the sea is most uninviting, though the low sandy hills, rather sparsely covered with scrub, do not suggest the deadly

fever that attacks all Europeans who live on the coast. As of most unknown lands, many tales are told of the hidden wealth of the country, of diamonds and rubies and gold; of missionaries who leave the country with their boxes stuffed with precious stones, and of mines where silver can be taken out by the handful. Probably, here as elsewhere, distance lends enchantment, and though there is undoubtedly a considerable *bona fide* trade to be done with Madagascar, the visions of rapid fortunes are as illusory as the above statements are vague.

On the evening of the second day after leaving Madagascar we saw opposite the setting sun a great mass of cloud rising out of the sea, and a little later we could see here and there between the masses of vapour the dim outline of the mountains in the Island of Bourbon. During the night we passed pretty close to the roadstead of St. Denis, and next afternoon, ten days after leaving Cape Town, anchored in the harbour of Port Louis in the Mauritius.

The first view of the island is pleasing — sharp picturesque peaks rise irregularly from the general mass of the land, and all the lower part is clothed with vegetation. Square bright green fields of sugar-cane were interspersed with irregular masses of darker green; and the whole was lighted up by the purple red flowers and foliage of the brilliant *Flamboyant* (*Poinsettia*), which gives an effect of colour analogous to that of red-tiled cottages in our own landscape.

In the narrow harbour we notice chiefly that in this, the hurricane season, the ships are all moored

with two anchors forward, and two strong moorings aft; also that in most cases the royal masts are struck.

The town of Port Louis is so unhealthy at this season that we were recommended to take train immediately up to Curepipe, a village in the centre of the island about 1600 feet above the sea, where fever is scarcely known. A few days afterwards Mr. Shand Harvey, one of the largest and most successful sugar planters on the island, invited me to his comfortable house at Vacoas, and to his hospitality I am indebted for many pleasant recollections of Mauritius.

It would be tedious to detail all our excursions, so we must content ourselves with a few characteristic sketches of man and nature in the Mauritius. In the centre of the island we find ourselves on a moderately high plain, round which several sharp volcanic peaks are dotted irregularly. To the north especially three peaks rise close together; a strange rock, like an upturned boot, rests on the farthest summit. This is the celebrated Peter Botte Mountain, famous in the naval traditions of Port Louis, some of which are well known through Marryat's novels. In a valley on the far side of this hill lies the scene of the celebrated romance of *Paul and Virginia*. To the left of this group a curious pointed peak is called "La Pouce," from a fanciful likeness which the sharp summit has to a thumb; while another mountain is called the "Corps du Garde," because some rocks on the side, when seen in profile, are supposed to resemble the gigantic form of a soldier lying on his back. In the foreground we see little but rows of bright

green sugar-canes. Between the rows lie long lines of big porous stones which keep the damp near the surface, and so help to nourish the plants. In the low canes the "Mynah" bird—a sort of black starling with white barred wings—rises at intervals for a short flight; while in the higher canes, a kind of scarlet sparrow, called the "Cardinal," flits among the long veined leaves.

Here and there gangs of Indian coolies perform the various operations which are necessary for sugar cultivation, always superintended by a negro half-caste, locally known as a "copper-coloured" man; creaking carts, drawn by great Madagascar oxen with huge humps and drooping dew-laps, carry the canes to the mill, the square chimney of which can be seen in the distance, and the white-coated, white-helmeted proprietor goes briskly over the various fields to keep everybody up to the mark. Add to this a clear horizon, firm detached cumulus floating slowly before a light south-east wind with a few wisps of cirrus above, over all a bright, glary, vertical sun, and we have a typical picture of Mauritius life and Mauritius scenery in the busy month of January.

It is very interesting to compare the scenery, vegetation, and climate of Mauritius with that of Fiji, which lies in almost the same latitude. The first thing which strikes the visitor is the untropical character of the vegetation. Low down near the coast no doubt there are banyan trees, and all over the island near the villages clumps of bananas, but only a small sprinkling of cabbage or of vacoa palms.

The bushes that cover the ground which has gone out of cultivation are only semi-tropical in character, and nowhere does one see the exuberant tangled growth, or the numerous parasitic plants and creepers which constitute the prominent features of a tropical jungle. While trying to discover the cause of this, I was fortunate enough to make the acquaintance of Mr. Horne, the director of the Botanical Gardens, near Port Louis, who some time before had spent a year in Fiji on a successful mission from the sugar planters in search of canes. He pointed out that all the land you see near Port Louis and the railway has been under cultivation from eighty to one hundred years; and that though the vegetation in the fragments of original forest which remain in the out-of-the-way portions of the island is much more truly tropical, still it is not so rank as in Fiji. This is partly due to the greater dryness of the Mauritius climate. Without going into figures, it is obvious to the most casual traveller that Fiji has by far the damper climate of the two islands. Mauritius is hot, but without the steamy depressing air of Fiji; damp clothes dry easily in the former island, but not during the rainy season in the latter; and while sugar cannot grow on the coast without irrigation in the Indian Ocean, the cane thrives best in the river deltas in the South Pacific. Perhaps the hurricanes have something to do with the vegetation. Tall trees stand a poor chance against the terrific squalls of a cyclone, and the sudden reversal of the wind from south-east to north-west ruins both canes and shrubs.

The difference in the healthiness of the two islands also presents some interesting features. Fiji has no fever, but a debilitating climate, sores which will not heal, a kind of ophthalmia and dysentery. Mauritius on the contrary has a malignant fever, a little dysentery, but practically no sores or ophthalmia, and, for the Tropics, a bracing climate. Taking an actual example, I found in a Fiji hospital about 50 inmates from among 600 coolies and Pacific labourers, while the day I went to the hospital in a healthy part of Mauritius, for a plantation that employed 1200 coolies, there was not a single patient. January is by no means the worst month for fever. Mortality from that cause rises from a minimum in November to a maximum in June. I had no opportunity of inspecting a plantation hospital near the coast, but still I suspect that there is more sickness, if less death, in Fiji than in Mauritius. The latter island is much less healthy than it used to be. Formerly it was a sanatorium for Indian civilians, and fever was unknown. About twenty-five years ago that disease was introduced; it is uncertain how, and now fever is the curse of the island. At the same time some people escape, and I met several Englishmen who had been from ten to twenty years in the island without the least touch of the disease. In every case they were men whose means had enabled them to live out of Port Louis, to have good food, and who habitually used boiled filtered water, and who lived prudently as regards diet and exposure.

A visit to a sugar mill at work is one of the sights

of Mauritius. Projecting beyond one gable of an oblong building, a revolving platform on an endless chain receives a continuous supply of canes from carts or from the carriers of a wire tramway. This platform leads the canes into the first set of rollers, whence a second revolving platform conveys them automatically to a second pair of rollers, from which a third platform carries the megass or crushed fragments into a cart to be dried and used as fuel for the boilers. The juice then goes through a variety of processes to get rid of the fragments of fibre and other impurities which still float in it. This is done by means of sulphurous acid and lime, by straining, boiling, and eventually filtering. The purified juice is then concentrated, first through what is called the "triple effect"—an economical method of using the same drying steam three times over—and finally in the vacuum pan. This is a large round copper boiler, from which the air is exhausted over the syrupy juice, so as to enable the final evaporation to be completed at a low temperature. By an ingenious contrivance samples of the granulating syrup can be taken out to watch the proper moment when the whole contents can be shot into large cooling vats below the pan. When cold you see in the vats a dark, almost black, mass, so thick with sugar crystals that it can hardly flow—in fact it is the sugar surrounded by black treacle. To get rid of the latter, small portions of the dark mass are put into the centrifugal machines. These are perforated baskets about 30 inches across and 24 inches deep, which whirl round at a very

high speed. You see the dark viscous mass fly up the sides of the basket and gradually get whiter and whiter as the treacle strains through the perforations, and leaves the white sugar crystals adhering to the sides of the vessel. After four minutes a little water is first sprinkled on the sugar to wash it, and then a little steam is turned on to dry it. The machine is then stopped, the sugar lifted in a coherent mass out of the basket, then crushed in a kind of rough coffee-mill, passed through a sieve to separate a few lumps which would interfere with the sale, and then packed into bags of vacoa palm leaves, and sent down to Port Louis. The time occupied from the moment the cane enters one end of the mill till the finished sugar leaves the other is about thirty-six hours.

The amount of matter which is taken from an acre of teeming tropical soil, the value of the product and the cost of production, form a curious contrast to the produce of an acre of cold English soil. Three thousand acres of canes require 1200 coolies to work in the busy season, at one shilling a day for the men and £4 to £6 a month for superintendents, besides many extras. An acre of soil yields on an average no less than 25 tons of cut canes, from which 2 tons of sugar worth £40 can be extracted. To get all this in the exhausted soil of Mauritius as much as £8 an acre has to be expended in suitable manure; while nature must supply a vertical sun, with not less than 60 inches of rain, pretty evenly distributed throughout the year. In England an acre of good soil will pro-

duce about 3 tons of wheat and straw, which together might fetch nearly £12.

We made one pleasant excursion to a mountain stream to try the novel sport of "cameroon" fishing. The cameroon is a crustacean, something between a very large fresh-water crayfish and a small ordinary sea-lobster. He lives under rocks and stones in small streams, and he is deservedly considered very good eating. When we got to a convenient place, one of the coolies put a small handful of spiced meal or *gram* on the bottom of the water, close to a rock on which we could stand. In a few minutes a black cameroon would come with his funny creeping walk and begin feeding on the bait. While so engaged we had a wand, about six feet long, ready, to the end of which was tied a small running noose. The loop was carefully passed under the animal's tail and lightly worked up to its middle, where a crayfish is very thin like a wasp. A sharp jerk then tightened the noose round the body, and the cameroon was easily landed on the bank. It was not so easy to take the noose off without being pinched by his powerful claws.

My chief object in going to the Mauritius was, if possible, to experience a hurricane, and also to visit my friend Mr. C. Meldrum, F.R.S., the director of the Meteorological Observatory at Pamplemousses, who has done so much to develop the practical handling of ships in the hurricanes of the Indian Ocean. As far as experiencing a cyclone was concerned, I was disappointed, though I was well repaid by being introduced to a very remarkable system of weather

forecasting, and by the collection of many minute details of hurricane weather, which could only conveniently be obtained on the spot. The Royal Alfred Observatory in Mauritius is situated near Pamplemousses station, about six miles from Port Louis. The surrounding ground is flat, and so far suitable for an observatory, but unfortunately Pamplemousses is one of the worst fever districts in the island. An attempt was made to have the site selected at a place called Moka, only a little farther off from Port Louis, and almost above the fever line. Unfortunately the government of the day ruled otherwise, and the staff of the observatory suffer in consequence. The main building is a substantial square structure, with verandahs running all round. The cellars contain the photographic self-registering meteorological and magnetic instruments; the ground floor is used as the office, and the upper rooms as the dwelling apartments of the director. The principal work of the establishment is to give time to the ships in Port Louis Harbour, by lowering a time-ball at 1 P.M., and, above all, to keep a vigilant look-out for hurricanes, and send proper notice both to the harbour and railway authorities.

When one of these visitations is expected, all railway traffic has to be suspended, and the rolling stock concentrated for shelter, as far as possible, under cover of the sheds in Port Louis. Otherwise carriages would be blown off the line and broken, and after the storm has subsided some of the bridges and the permanent way are sure to have been carried away either by

wind or flood. Every householder secures his doors and windows with the strong iron hurricane bars that are to be seen in every building, and all cattle, sheep, poultry, etc., are driven at once into shelter.

Fortunately it is not once in ten years that the full violence of the kernel of a hurricane reaches Mauritius, though every year the island suffers more or less from the outskirts of one of these cyclones. We were met on first landing with a sickening stench, caused by the rotting of many fish and crabs which had been thrown up a week previously by the heavy surf of a distant hurricane. In Mauritius there had only been three or four days of continuous heavy rain, with strong wind, but nothing worse.

Though numerous descriptions of hurricane weather have been published, still the following account of some of the minuter details may be interesting, and will, I think, remove the doubts which some have as to the identity in character between tropical hurricanes and the cyclones of our own country, inasmuch as not only the general features but even the details of clouds are all nearly identical. The description is chiefly taken from the works of Meldrum and Bridet, and from conversations with the former, and other residents in Mauritius.

As much as five or six days before the arrival of the hurricane long wisps of cirrus cloud—"mares' tails," or what the French call "cats' whiskers"—begin to cover the sky. Later on the filaments become less accentuated, and either transform themselves into a kind of pale milky atmosphere, in which

halos are frequently observed, or else the cirri resolve themselves into cirro-cumulus. All this time the barometer falls very slowly, and then the sea begins to speak. Two or three days before the arrival of the cyclone a peculiar tide-race (*raz de marée*) agitates the ships which are at anchor, dragging the water, as it were, along the bottom of the sea, and sometimes entirely altering the shape of a sandy coast; while a little later a mountainous swell rolls in, and breaks with a roar that is always ominous, in the hurricane season. Now temperature begins to increase, but the oppressive sensation which it brings is much greater than the actual rise of the thermometer would suggest. At this moment the direction of the wind presents very uncertain indications. Sometimes a stupefying calm, accompanied by puffs of suffocating air, precedes the arrival of a hurricane; other times light breezes from all directions fail to announce in any way the future direction of the wind. Then the appearance of the sky at sunrise and sunset furnish other premonitory symptoms. The clouds—cirro-cumulus or cirro-stratus — are coloured orange-red, and this coloration causes such a magnificent cloud pageant that even those who do not doubt the imminence of the danger are constrained to admire. As the cyclone approaches, this red colour takes a weird copper tint of sinister augury, and admiration changes to a well-founded apprehension.

Later on cumulus cloud presents itself, allowing the upper cirrus to be seen only at rare intervals, and twenty-four hours before the first squalls a thick

layer of cumulo-nimbus concentrates itself on the horizon between the north-east and south-east.

By this time all nature is alive to the approach of some catastrophe. The leaves of the trees moan without any wind, and low sounds are heard in the mountains. Wasps and cockchafers swarm into houses; the sea-birds—the *paille-en-cou*, the frigate bird, and the *coupeur d'eau*—take refuge ashore, and fill the air with their screams.

Lastly comes nimbus, low and flying rapidly, while the air on the earth's surface is almost calm, and then the first squall of the hurricane bursts with all its fury amidst a downpour of rain. If we are exactly on the line of the path of the cyclone's centre, the barometer now begins to fall very fast, the rain to pour down in torrents, and the squalls from the south-east to increase in violence. The character of these latter is one of the most marked peculiarities of a hurricane. The wind seems to lull for a moment, and then to come down with a burst, and the roar of a heavy piece of ordnance—in fact, an exaggeration of that form of gustiness which is known to seamen as "blowing great guns." All of a sudden the wind falls, the clouds begin to break, and blue sky appears. We might think that the storm was passed, but the barometer remains at its lowest point: we are in the most dreaded portion of a cyclone—the central vortex. After three or four hours the sky looks black to the north-west, and the hurricane recommences suddenly with a tremendous squall from the quarter exactly opposite to the previous wind, and

heavy rain comes on again, with a rapidly rising barometer. After a somewhat shorter period than that which elapsed between the disappearance of blue sky and the arrival of the central vortex, the clouds begin to break for the second time. Between the openings in the driving scud, beautiful flecks of granular cirro-cumulus are seen floating in the upper sky, and gradually, as the wind falls, the rain clears off, and the usual trade wind cumulus announces the return of settled weather.

We can now survey the damage which the hurricane has wrought. At sea a ship which encounters the vortex of a cyclone frequently founders, and never escapes the loss of spars or masts, or damage done by seas sweeping over her. On land the sudden reversal of the wind not only ruins the sugar-canes, but also the maize and bananas, which form the staple food of the inhabitants. Even the leaves of trees which have not been uprooted are dried up and blackened as if they had suffered the action of fire. Famine therefore follows the track of a hurricane, and pestilence closes up the rear. The heavy seas and tide-race throw up quantities of dead weed, fish, and crabs above the usual high-water mark, which putrefy in the sun, and frequently develop an outbreak of deadly fever.

The reader will remark the absence of any electrical manifestations. If there are any signs of bad weather, and thunder or lightning are observed, people say at once,—"No hurricane."

Such is the hurricane,—the most destructive

manifestation of weather with which we are acquainted, save only the tornados of the United States. These are simply exceptionally violent whirlwinds, the breadth of whose area of destruction does not often exceed 300 yards. The length of the path is usually less than twenty miles, which would be traversed in less than an hour; when the whirl, which probably never extended 2000 feet above the earth, would die out. The diameter of the hurricane, on the contrary, may be from 300 to 500 miles across, the length of its course some thousands of miles, and the duration from ten to fifteen days. The vertical height is certainly small, probably not more than 30,000 feet at most. So that though both are whirling masses of air, their dimensions are very different; for while the size of the one is measured by yards, and its life by minutes, the extent of the other is reckoned by miles, and its existence by days. The great work of Mr. Meldrum's life has been the discovery of certain modifications of the old crude idea that the wind blew in a circle round the vortex of a cyclone. His researches have led to some new and very important rules for the safe handling of ships in hurricanes; but as the details are rather technical, we have relegated a brief account of his investigations to Appendix III.[1]

The system of forecasting the approach of a hurricane, which is employed by Mr. Meldrum with great success, is very interesting. There are always two

[1] These rules have been further developed and systematised by the Author; v. *Proc. Roy. Soc.*, London, vol. xliv. p. 314.

ways of forecasting. A forecaster with abundant telegraphic communication from other countries, has the barometric height, the wind and weather, wired up to him from many surrounding places. From these he constructs a synoptic chart, and deduces his forecasts from an inspection of the isobars and other data. This is the best way of forecasting, but an observer at a place like Mauritius, which has no telegraph, is obliged to deduce forecasts entirely from the readings of his own instruments, from the appearance of the sky, and very largely from a minute knowledge of the nature and ways of cyclones in his own district. He must know the size and progression rate of cyclones, and the paths which they usually traverse. Then he can tell from the way the wind changes whether the centre will pass north or south or east or west of the island, and issue his forecasts accordingly. The most interesting feature of the system to a European forecaster is the care which must be taken to allow for the diurnal changes in the height of the barometer. In England these changes are so small that they may be neglected, but in the Tropics the mercury falls regularly from 1-10th to 1-12th of an inch between the hours of ten and four, both by night and day, and rises an equal amount between four and ten. An inexperienced observer might then easily mistake the diurnal rise for a real increase of pressure, and forecast an absence of danger, while a distant hurricane was really approaching. For instance, during the slow fall which commences four or five days before the arrival of the true hurricane, the diurnal changes

are superimposed on the steady general fall of the barometer. When a hurricane is expected the director has to be on the watch night and day; and the telegraph offices are kept open so that due notice may be given of any shift of wind or approach of heavier weather. No forecasting would be possible if cyclones did not move more regularly in the Indian Ocean than over Great Britain; hurricanes are forecast with greater success in Mauritius than in any other tropical country we have visited, and this satisfactory result is entirely due to Mr. Meldrum's skill, experience, and enthusiastic devotion to the work.

CHAPTER XIV

TO CEYLON: THE SHADOWS OF THE PEAK

As no suitable ship was going from Mauritius to India, we took a passage in one of the fine boats of the Messageries Maritimes Company for Adelaide. Meteorologically the voyage promised to be of some interest and to enable us to examine the region between the south-east trade and the westerly winds of high southern latitudes; but we were disappointed, though the cool breezes were a pleasant change from the stuffy heat of Port Louis. We sailed a great circle course, which saved eighty miles in distance, and took us as far as 39° south latitude, where we might have expected to meet with westerly winds; but the whole fourteen days which the voyage lasted we experienced nothing but light winds from south-east to north-east, and had smooth water the whole way. The sky was generally overcast with ill-defined clouds, a monotonous, uninteresting expanse of vapour, with a dark dull sea, over which the great white albatrosses flew persistently in the wake of the ship. The evolutions of these birds were always singular. The ease with

which they circled round the ship, which was doing thirteen knots an hour against the wind, and the manner in which they flew, while scarcely flapping their wings, always excited our astonishment.

We spent a week in Adelaide, very pleasantly, waiting for the Ceylon steamer. My friend Mr. W. E. Cooke, of the South Australian Observatory, showed me over the building, and explained the meteorological organisation of the colony. One of the most interesting instruments was the tank for measuring the evaporation of water. It was a box full of water about one yard each way, sunk in a tank of water to prevent the sides from getting hot. A suitable float and vernier provided means for measuring the height of water in the box; while a convenient tap was provided for filling the box up to standard level every day. In summer time they often evaporate four-tenths of an inch in a day, and as much as half an inch has been recorded on extreme occasions. Mr. Cooke was making drawings of the markings on Jupiter with the 8-inch refracting telescope of the observatory. It has always seemed to me possible to gain some insight into the nature of our own planet's atmosphere by observing the markings on Jupiter and the changes in the planet Mars. We spent a portion of one night together looking at the so-called ice cap of Mars, and the markings and red spot on Jupiter, and discussing how far the dark bands, and moving white spots on the latter planet, are analogous to the blue sky or moving cloud of our own anti-cyclones or cyclones. Certainly the appearance of the dark bands on Jupiter

hardly suggests to my eye an arrangement of blue sky such as holds in this our world, but perhaps if charts of our earth were constructed to show the distribution of blue sky and cloud on two or three successive days, more resemblance might be seen. At the same time the physical conditions of Jupiter are very different from those of our own planet.

Here too we had the pleasure of making the acquaintance of Mr. C. Wraggè, to whose energy and perseverance the establishment of an observatory on Ben Nevis is chiefly due. We walked to the top of Mount Lofty, 2133 feet high, and about ten miles from Adelaide, where he had established some self-recording instruments to compare with his observations on the plain near Adelaide. The view from the top is very striking; below lie Adelaide plains, with the city surrounded by a rim of park land, looking like a great chess-board. Straight roads lead into the town on all sides, while the blue sea shimmers in the hazy distance. Behind us stretches a monotonous rolling country, covered with uninteresting shadeless gum-trees, and overhead the fierce sun of an Australian summer beats down from a cloudless sky.

On the 30th January 1886 the S.S. *Valetta* sailed out of Glenelg Bay — the port of Adelaide — for Colombo. Two and a half days' steaming against strong or fresh south-west winds brought us to the town of Albany at the head of King George's Sound in Western Australia. We only stayed there a few hours, so we landed as soon as possible to try and see some natives who live near the town. With a little

trouble we found a man and woman driving some sheep, and after some difficulty persuaded them to be photographed. One of these pictures is reproduced in Plate VI. Unfortunately they had no boomerangs, only a throwing-stick for the spear. They were certainly very black, and of a very low type of humanity, but to my mind no more approached the ape than the negro. When I showed the pictures, however, to my friends in Borneo, they instantly remarked on the likeness to the orang-outang, both in expression and in the manner of grasping a throwing stick. One thing struck us as very noticeable. Englishmen when they settle in Australia get a peculiar roughness about the hair and beard that they rarely have at home, but which is typical of the Australian aboriginal. In like manner, as mentioned in Chap. I., the citizens of the United States have acquired the peculiar lank hair of the Red Indian, and it is to some climatic influence that we must probably look for the explanation of both changes.

Leaving the town of Albany in the afternoon, we rounded Cape Leeuwin in the early morning of the next day, and almost immediately picked up the south-east trade. This was fortunately moderate, for sometimes the wind blows strongly in the summer months. During the whole four days which we ran before this trade the sky was never really clear, for though there was sometimes what ought to have been blue sky between patches of rather ill-defined stratus or strato-cumulus, the colour was always pale, and

Plate VI.

Natives of West Australia.

the clouds were curiously dull. It is just possible that some of this haze may have been due to Australian dust.

On the morning of the fifth day after rounding the Leeuwin, we passed under the sun's place at 4 A.M.; the south-east wind fell very light, though a considerable swell set in from westwards, while the air grew much hotter and closer, rising to 86° in the cabin. At 6 P.M. a heavy bank of black cloud was seen to the north-west, and though the surface wind still held from the south-east, the lowest clouds were from north-east, and a middle layer from nearly north. At 7 P.M., in about 12° south latitude, the wind suddenly jumped to north or north-north-west, temperature decreased considerably, while the sky began to clear; and by ten o'clock was quite starry. This was the meeting of the south-east trade and the north-west monsoon, with a sort of undeveloped squall or shower, but there was no "doldrum" or calm belt.

Next day we were well in the north-west monsoon, with the typical weather of that region. A long uneasy westerly swell furrowed the sea; the air was warm and soft, though the thermometer was 5° lower than on the previous day; few or no clear spaces appeared in the sky, but only driving masses of shapeless clouds, all mostly dark and at many levels. Sometimes black cumulus rose before an ill-defined shower, as the whole drove in front of a north-westerly wind, which whitened the sea as the squalls bore down upon the water. Just before sunset I

was fortunate enough to get a peep of very high cirrus through a rift in the lower clouds, and found it travelling from the east.

The following day, 11th February, the weather grew much finer, and for the first time since leaving Albany we were able to photograph the clouds. The succeeding day, when we approached and crossed the Equator, was even finer, for we were running into the clear weather of the north-east monsoon. The sunrise that morning was singularly beautiful and characteristic of the Tropics. A dead calm left an oily surface on the sea, that reflected every changing tint of the sky. A brilliant, transparent blue overhead just showed a few stars and planets through the brightening light of dawn. A line of small detached cumulus, which rose into little heads of cloud, ran all round the horizon, and formed a circle that seemed to centre in ourselves. Very rarely, a light soft patch of shapeless vapour, ever varying in colour, drifted overhead, and it was difficult to recognise this as the undersurface of one of the little cloudlets that looked so beautiful on the horizon. Just as the brilliant purple foreglow illumined the sea, a fan-shaped sheaf of pink crepuscular rays shot up into the sky from the sun's place just below the horizon for a few minutes. All this time the circle of clouds was constantly changing colour, whichever way you looked, but mostly on the side of the rising sun. After sunrise, however, the brilliancy of the eastern horizon diminished; but then the western sky and clouds took up the play of colour, and the pageant continued till the uniform

brightness of day chased every tint of dawn away, only to return at night with increased splendour.

The next two mornings the sun rose with equal magnificence, and on both occasions we witnessed, for a few minutes, the rare occurrence of crepuscular rays in the east being continued or reflected into the western horizon, where they appeared as a few faint orange-purple streamers, converging to a point on the horizon exactly opposite the just-risen sun. These are called anti-crepuscular rays, or rays opposite to twilight.

This portion of the voyage across the Equator, and the meeting of the trade with the monsoon, was the most interesting to us, as the study of the upper wind currents in that region was one of our special objects of inquiry. At sunrise and sunset there was far the best chance either of seeing high clouds at all, or of determining their motion, and we deemed it advisable to be on deck not later than 5.15 every morning. The results entirely confirmed the observations on the previous voyage, for the highest cirrus over the north-west monsoon always came from some point of east.

On the morning of the 14th February we sighted Point Galle on the southern coast of Ceylon, and cast anchor the same afternoon in the harbour of Colombo. The first aspect of the island was disappointing — a long stretch of low mountainous country without any striking peak to give a point to the landscape,—and a featureless mass of cumulus cloud lying over the land, while the rest of the sky was bright and blue, was equally uninteresting.

At Colombo we seemed to have arrived at a world very different to that from which we came. We left a brown arid land, with few shadeless trees, a sparse population, a town where well-dressed dock labourers, working almost in silence, can dictate to shipowners what crews they may engage, and where perhaps one prosperous-looking porter condescends to handle your baggage, at whatever pace he pleases, for a high remuneration. Here we are in a land fringed with palms and clothed with luxuriant green undergrowth, where a screaming crowd of scantily-clad natives fight with one another to perform the slightest service to the traveller, for whatever remuneration he may please to give.

The railway journey from Colombo to Kandy, in the centre of the island, is very interesting. The line first runs along narrow flat bottoms covered with paddy (rice) fields. Here and there a white paddy bird—a sort of heron—flies along, and then suddenly seems to disappear as he folds his white wings, and leaves nothing to be seen but his gray-brown back, that is hardly distinguishable from the earth on which he stands. In places the nose and horns of the buffalo (*bœuf à l'eau*) are just visible above the surface of a cool pool; while at intervals brown, scantily-clad natives are bathing, fishing, or working the ground, as the case may be. The jungle—all secondary—starts abruptly from the level ground. The fringe is usually a bush with brownish orange flowers and black berries, the "lantana" of Ceylon, or the "Old Maid" of Mauritius. Above this and other

shrubs rise the crooked stems of the cocoa-nut, and the straight trunk of the areca-nut palm, but few parasites, or creepers, or tree-ferns, as in Fiji or Brazil. Here and there the brown roof of a native hut peeps above the scrub, while a steamy air, a bright cumulus-decked sky, and a burning sun complete the picture.

Through the kindness of our friend, A. C. Laurie, Esq., the district judge of Kandy, we had an opportunity of seeing the celebrated shrine which contains the tooth of Buddha under very favourable circumstances. This typical combination of "temple and palms" is a portion of the old palace of the kings of Kandy, partially surrounded by cocoa-nut palms, and encircled by a shallow moat. When we had mounted the first staircase we came to a small court where some men were tom-toming, and playing on a sort of pipe; then more steps, and we entered a small room, where a crowd of worshippers—mostly women—were offering flowers and fruit to the shrine where the sacred relic was preserved. Even the shrine they could not see; but we were allowed to enter. First we passed through a curtained door into a sort of antechamber, then through another curtain and another door—this last of ivory and gilt metal—into the innermost room. This was a small, low chamber, rather longer than it was broad. At one end stood a sort of iron cage, secured by three different padlocks; and three different men, all jealous of one another, guarded respectively the several keys. Inside the cage a sort of square bell-shaped cover, called a dagoba,

which cáps two smaller but similar covers, conceals the sacred relic, that is only exposed to the public gaze at very rare intervals. The present relic is said to be a piece of ivory, as the original tooth was taken by either the early Portuguese or Dutch conquerors. Outside the dagoba hang votive offerings, such as kings' necklaces, so long that they hang down the whole front of the body, and dull embroidery inlaid with rough rubies, uncut sapphires, moon-stones, and many other precious gems. Before the bars of the iron cage stands an eight-sided silver table quite three feet across, and on it lie more valuable votive offerings of rare silk stuffs, gold vessels, gold fly whisks, and similar Oriental valuables. Other rooms in the temple contained more treasures. In one we saw large gold water vessels; in another a crystal image of Buddha, ten inches high, protected by an ivory and silver case. Still more interesting was the octagonal chamber containing the library, where a studious-looking priest took charge of some valuable religious manuscripts. These were very curious, as they were all written on slips of Talipot palm leaves, a foot or eighteen inches long, and only about two inches wide. A hole was bored near either end, and the leaves strung together with a wood board top and bottom. In the more valuable manuscripts the covers were enriched with elaborate silver ornaments.

The images of Buddha are frequently represented with the head in the centre of conventional diverging rays of light; and they say, in the figurative symbolical language of the East, the head of Buddha is sur-

mounted by *agni* (fire)—the emblem of the sun. The idea is doubtless partly due to the general belief in the sun as the centre of brightness, but still more to that appearance of rays diverging from the sun when behind a cloud which we have before described. We saw in Chap. VII how the Pacific islanders call this beautiful phenomenon "the ropes of Maui," and that in England country-folk talk of the "sun drawing water" when they see the same appearance. The Singhalese call these diverging beams of light "Buddha's rays." The natives attach superstitious dread to their appearance, and believe them to be portentous of misfortune in every month except May, which for some reason is exempt. The cloud which particularly favours the development of rays is that thin, patchy, strato-cumulus which we have before described and illustrated in the sketch p. 172. I never saw any approach to that form of cloud in Ceylon, and doubt if it is common in the south-west monsoon, so it is just possible that the rays may precede some kind of bad weather. More probably the superstition may be due to that vague dread of evil which any unusual appearance in the sky inevitably suggests to the savage mind.

The daily sequence of cloud at Colombo during the north-east monsoon was as follows:—The early morning was always cloudless, or perhaps a few light cirri might be visible. Soon after sunrise a little detached cumulus—firm but not angry—appeared in the sky; but these could not be photographed, as the surrounding blue was too white with the steamy haze of the

Tropics to give the necessary contrast. By midday these clouds had almost disappeared, till at sunset they reformed with a little cirrus high overhead, only to disperse completely as night came on. During the south-west monsoon this sequence is probably entirely altered, but there would be still less chance of forming ray-producing strato-cumulus. The prevailing direction of the wind during our visit was from the northwards. At night it came from the north-east, but worked round during the day under the influence of the sea breeze. The turns were first by north to north-west or even west in the afternoon, and then back again the same way till at nightfall the north-east direction was regained. The inhabitants call this north-easter the "long shore" wind, and for some reason dread it. They say it brings damp, and even close their windows against it. Curiously enough, at Madras we found another "long shore" wind from the south-east equally unpopular; and though it is difficult to assign any satisfactory reason, there can be no doubt that these winds are really trying and unhealthy.

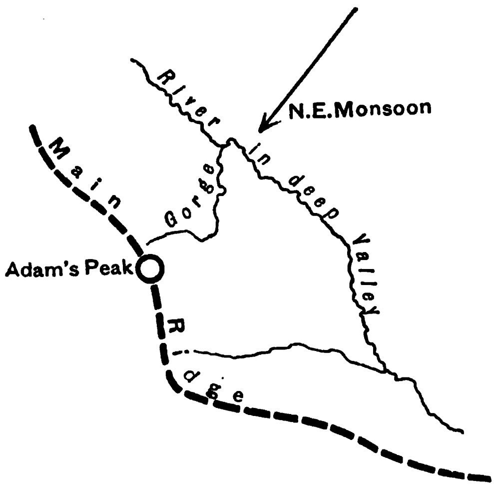
The Botanical Garden at Peradeniya, about a mile from Kandy, is one of the sights of Ceylon. At the entrance we are met by a small avenue of large india-rubber trees, whose curious roots wind along the ground, like gigantic tapeworms wriggling on their thin sides.

The Talipot palm, whose leaves supply the material for the Buddhist books, was among the most interesting objects to the casual visitor. It lives from thirty

to fifty years, then flowers, seeds, and dies. We saw a fine one in this last stage. Nearly all the leaves had fallen off, and a great bare bunch of small fruit stood at the top of the tall stem. The two commonest palms in Ceylon are the cocoa-nut and the areca-nut. The former has always a crooked stem, the latter is always conspicuous by its straightness. Nearly every man and woman you meet has red lips and saliva from chewing betel leaf and areca-nut. A portion of the nut is wrapped up in a betel leaf with a small bit of lime, and chewed for half an hour. It is pleasant to taste, being aromatic and astringent; and doubtless serves as a useful stomachic to a race that subsists almost entirely on vegetable diet.

One special object of coming to Ceylon was to ascend Adam's Peak, and investigate the curious shadow that appears at sunrise, about which so much has been written, and so many theories have been proposed. The shadow was described as seeming to rise from the ground and stand up in front of the spectator, in the form of a gigantic pyramid, and then either to disappear altogether, or to fall down suddenly to the earth. Distant objects, a hill or a river (or even Colombo itself at a distance of forty-five miles), it was asserted, might be seen distinctly through it, so that the shadow was not really a shadow on land, but a veil of darkness suspended between the observer and the low country. This peculiar appearance seems generally to have been attributed to a sort of mirage; but the sequel will show that this theory cannot be maintained.

Adam's Peak rises in an abrupt cone more than 1000 feet above the irregular mountain chain to which it belongs. The summit reaches to 7352 feet above the sea. On the south side the mountain falls suddenly down to Ratnapoora, very little above the sea level; while on the north it slopes irregularly to the high valley of the Maskeliya district, nearly 4000 feet above the sea. It also lies nearly at an elbow of the main chain, as shown in the accompanying engraving, while a gorge runs up from the north-east just to the north of the mountain. When, then, the north-east monsoon blows morning mist up the valley, light wreaths of condensed vapour will pass to the west of the peak and catch the shadow at sunrise, if other things are suitable. The importance of this will appear later on.



TOPOGRAPHY OF ADAM'S PEAK.

The only difficulty in getting to Adam's Peak is the want of a rest-house within reasonable distance of the summit. Fortunately the kindness and hospitality of T. N. Christie, Esq., of St. Andrews Plantation, Maskeliya, enabled us to make the ascent with the greatest ease and comfort, and to obtain unequi-

vocal evidence of the true nature of this curious shadow.

The road to St. Andrews was characteristic of the plantation district of Ceylon. Above the line of such tropical vegetation as palms and bananas, we drove for twenty-five miles from Hatton Station over hills covered with plantings of tea, coffee, and chincona. The small dark-leaved tea bushes, 3 by 2½ feet apart; the lighter-leaved coffee, with its white flower and orange berry, 5 by 5 feet apart; and the still larger-leaved, many-tinted, deep-veined chincona, at still wider intervals, were all easily recognised. Occasionally on the higher hill-tops traces of the primeval forest of Ceylon could be observed. At Maskeliya the carriage road ended, but we met our friend's coolies, who carried our baggage through three or four miles of plantations to St. Andrews, some 4200 feet above the sea level. The weather was looking far more unsettled than it had been lately, for ragged clouds lay below and a veil of cirro-stratus above. In the morning the latter took the form of thin crossing filaments of cloud, known as reticulated cirro-stratus, which we have never elsewhere seen in the Tropics. This augured ill for the success of our expedition, but in the end it was the rather disturbed weather that gave a clue to the formation of the shadow, which might have been wanting under more settled conditions.

The next morning things looked even worse. Heavy rain-charged clouds covered the sky, and shortly after midday a distant thunderstorm gave

every indication of broken weather. However, at 2.45 P.M. 21st February 1886, a party, consisting of Mr. G. Christie, Mr. Bower, Professor of Botany in the University of Glasgow, and the author, started, with half a dozen coolies, to ascend the peak. For the first hour we walked through various plantations till we came to a river at 5000 feet above the sea level. This we crossed, and entering the jungle commenced fairly to climb the range from which the peak projects. The next hour's walking was up a steep narrow path cut out of the jungle—a regular staircase of roots and stones. The vegetation was dense on either side with many plants, but with few creepers. A small bamboo—dear to the elephant—with a kind of wild asparagus, and many dark small-leaved trees of the myrtle tribe, were the most conspicuous features of the vegetation. Then we came to a place called Usemelly, where, at 6100 feet, two ruined houses stand, about the level of the spur or col which connects the peak with the surrounding range.

Finally we climbed the rocky pinnacle which we now saw towering above us, where the ascent was so steep in places that steps had been cut in the sheer rock, and chains laid at the side of the path to assist aged or infirm pilgrims. We gained the summit just before sunset, exactly three hours after leaving the St. Andrews bungalow, so that we had rather exceeded the Alpine average of climbing 1000 feet an hour at low levels. Rain and mist had pursued us most of the way, and now the peak was enveloped from time to time with wreaths of mist.

The summit may be described as a flat, irregular platform, about 64 by 45 feet. A rock projects from about the centre of this, and on the apex of the rock is carved a gigantic footstep of Buddha, three or four feet long. An iron cage protects the sacred relic, and the whole is surmounted by a wooden shrine. Crowds of pilgrims come up every morning during the fine weather of the north-east monsoon, to offer flowers to the relic, and salute the rising sun with cries of "*Saadoo*" (Amen). On the platform are large stands for candles, and braziers for incense or charcoal; also a bell for the pilgrims to strike, and a house for the priest to live in. Below the level of the platform there are one or two unfurnished sheds to shelter pilgrims. One of these was cleared out for us, and after a capital dinner we lay down to rest as well as the wind and dirt would permit.

The wind roared round our shelter hut till two o'clock in the morning, when it seemed to subside a little. At half-past five the sky was covered with a confused mass of nearly every variety of cloud. Below and around us lay cumulus and mist, at a higher level pure stratus, and above that wild cirro-stratus and fleecy cirro-cumulus.

Soon the foreglow began to brighten the under-surface of the stratus cloud with orange; lightning flickered to the right of the rising sun, over a dense mass of cloud; opposite the dawn a light pink-purple light illumined an irregular layer of condensed vapour; while above, a pale moon, with a large ill-defined

corona round her, struggled to break through a softish mass of fleecy cloud. Below lay the island of Ceylon, the hills and valleys looking like a raised relief map; patches of white mist filled the hollows; true cloud drove at intervals across the country, and sometimes masses of mist coming up from the valley enveloped us with condensed vapour.

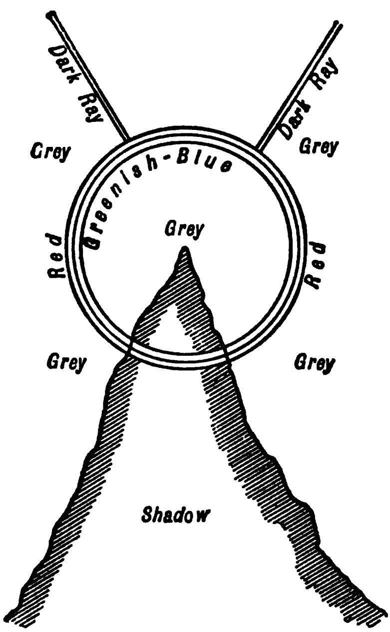


DIAGRAM OF RAINBOW ROUND THE SHADOW.

At six o'clock the thermometer marked 52°. We had been told that the phenomenon of the shadow depended on the temperature at the summit falling to 30° or 40°, and when, shortly after, the sun got up behind a cloud, we had almost lost all hope of seeing anything. But suddenly, at 6.30, the sun peeped through a chink in the clouds, and we saw the pointed shadow of the peak lying on the misty land. Driving condensed vapour was flying about, and a fragment of rainbow-tinted mist appeared near the top of the shadow. Soon this fragment grew into a small complete prismatic circle, the red being outside, with the summit of the peak as a centre. I instantly saw that with this bow there ought to be a spectral Brocken

figure, so I waved my arms about, and was delighted to find shadowy arms moving in the centre of the rainbow. Two dark rays shot outwards and upwards on either side the centre, and appeared to lie nearly along a prolongation of the lines of the slope of the peak below, as shown in the diagram. The centre of the bow appeared to be just below the point of the shadow, not on it—that is to say, the pointed shrine gave the top of the shadow, while the subjective bow centred round our own eyes on the platform below. If we did not stand fairly out in the sun only a portion of the bow could be seen. Three times within a quarter of an hour this appearance was repeated as mist drove up in proper quantities, and fitful glimpses of the sun gave sufficient light to throw a shadow and form a bow. In every case the shadow and bow were seen in front of land, and never against the sky. The last time, when the sun was pretty high, we saw the characteristic peculiarity of the shadow. As a thin wreath of condensed vapour came up from the valley at a proper height, a bow formed round the shadow, while both seemed to stand up in front of us; and then the shadow fell down on to the land, and the bow vanished as the mist passed on.

Here, then, was an unequivocal explanation of the whole phenomenon. The apparent upstanding of the shadow was simply the effect of passing mist, which caught the darkness of the peak at a higher level than the earth, for, as the condensed vapour moved on, the characteristic bow disappeared and the shadow fell to

its natural plane on the ground. When the mist, as on the first and second occasions, was low, the shadow fell on the top, as it were, and there was no appearance of lifting, only the formation of a bow.

The theory is that white light reflected from water globules forms a series of circular bows, according to the size of the globules, their closeness, and the brightness of the illumination. Had the mist been so fine and thin as merely to catch and raise the shadow, but not to form a bow, there might have been some doubt as to the origin of the appearance. Our fortune was in the unsettled weather, which made the mist so coarse and close, that the unequivocal bow left no doubt as to the true nature of the cause.

About an hour later the sun again shone out much higher and stronger than before, and then we saw a brighter and sharper shadow of the peak, this time encircled by a double bow. Our own spectral arms were again visible, but the shadow was now so much nearer the base of the peak, and we had to look down so much on it, that there was no illusion of standing up, and there were no dark diverging rays. The inner bow was like one we had seen before, and the shadowy figures were confined to it; the outer and fainter bow was due to the stronger light.

An explanation of the shadow was published some years ago in an English scientific journal by a gentleman who, though some time resident in Ceylon, had never seen the shadow, though he had frequently heard it described. He assumed that the average temperature in the low country was between 70° and

80° F., whilst that on the summit was from 30° to 40°. Consequently, he says, the lower strata of air are much less dense than the upper; and he attributes the lifting of the shadow to a sort of mirage effect.

Our own thermometric observations, let alone the discovery of unmistakable fog phenomena, conclusively disprove this hypothesis. At 6 A.M. the thermometer on the peak stood at 52°, and through the courtesy of the Surveyor-General of Ceylon I find that the temperature in Colombo at the same moment was a trifle over 75°. The difference of 23° is just about what is usual in a height of 7300 feet, so that the idea of mirage cannot be entertained.

The questions have been frequently asked why this lifted shadow should be peculiar to Adam's Peak, why a similar appearance should not be observed from any other mountain-top, and why the shadow should not be seen at sunset? The answer seems to depend on the height, the isolation, and the contour of the surrounding hills, and the difference between sunrise and sunset clouds. There are not many mountains, which are habitually visited, that are either over 7000 feet, or that rise in a well-defined isolated pyramid. Still fewer can there be where a steady wind, for months together, blows up a valley so as to project the rising morning mist at a suitable height and distance on the western side, to catch the shadow of the peak at sunrise. The shadow is not seen during the south-west monsoon, for then the mountain is covered with cloud and deserted. Nowhere either do we find at sunset those light mists lying near the ground, which are so characteristic of

sunrise, and whose presence is necessary to lift the shadow. The combination of a high isolated pyramid, a prevailing wind and a valley to direct suitable mist at a proper height on the western side of the mountain, is probably only rarely met with, and at present nothing yet has been described that exactly resembles the sunrise shadow of Adam's Peak in the green island of Ceylon.

But there is another totally different shadow which is sometimes seen from Adam's Peak, just before, and at the moment of sunrise, that has been mixed up in some accounts with the shadow we have just described. The shadow of the base of the peak stretches along the land to the horizon, and then the shadow of the summit appears to rise up and stand against the distant sky. The first part is the natural shadow lying on the ground; and the sky part is simply the ordinary earth shadow of twilight projected so clearly against the sky, as to show mountainous irregularities of the earth's surface. As the sun rises, the shadow of the summit against the sky gradually sinks to the horizon, and then the ordinary shadow grows steadily shorter as the sun gets higher in the usual manner. This can only be seen at sunrise from Adam's Peak, because the ground to the east is too high and mountainous to allow the shadow of the summit at sunset to fall on the sky before the sun is too far down.

We found on our homeward voyage a similar effect, only at sunset, reported on Pike's Peak, Colorado, 14,147 feet above the sea, and nearly double the height of Adam's Peak. There, towards

sunset, the shadow of the mountain creeps along the level prairie to the horizon, and there begins to rise up in the sky till the sun has just gone down, and the anti-crepuscular shadow rises too high to catch the outline of the peak. We only witnessed a portion of this sequence, for just about the time that the shadow stretched to the horizon, clouds obscured the sun, and the rise of the shadow could not be observed; but from all the descriptions we heard, there can be no doubt that the character of the shadow is identical with that of Adam's Peak, only that, as the order of sequence is reversed, it is more easy to follow the origin of the shadows.

On a subsequent occasion we have watched every stage of the same sunset shadow from near the top of the Peak of Teneriffe, and there the same shadow on the sky is seen both morning and evening owing to the isolated position of that mountain. The well-known traveller Miss C. F. Gordon Cumming exhibited at the Colonial Exhibition in 1886 a drawing of the shadow as she saw it some years before. This picture represents the shadow lying down, but not raised, on an irregular surface of white mist and mountain-tops. The most interesting thing is a prismatic fringe of colour along the straight outside edges of the shadow; but there is no trace of a bow round its point.

When we consider how much the appearance of the shadow depends on the height, size, and aggregation of the mist, we need not be surprised at the numerous phases of reflection and refraction that

have been described by travellers; but the general principles which we have just explained appear to govern all.[1]

[1] For full details of these shadows see Abercromby, "On the peculiar sunrise shadows of Adam's Peak, Ceylon."—*Phil. Mag.*, January 1887.

CHAPTER XV

THE HIMALAYAS: ALPINE SCENERY

We left Colombo on the afternoon of the 25th, and anchored off Madras by early morning on the 28th of February 1886. The whole time we experienced nothing but fine weather, with light north-easterly winds, very little cloud of the small cumulus kind, and usually a good deal of white haze in the sky. The thermometer in the cabin only ranged from about 77° to 84°, for we were still within the last breath of the north-east monsoon. The night before reaching Madras the sun set in a curious brick or furnace-red sky, very brown or black on the horizon. Everybody said at once, "Oh what a regular Indian sunset." The coloration was undoubtedly due to dust in the air, and recalled a somewhat similar appearance in the Red Sea.

The *Valetta* only stayed for twelve hours at Madras, and as it was Sunday all the offices and English shops were shut. We were anchored in a small square harbour formed by an artificial breakwater. The whole front of the latter had been thrown down in a cyclone eight years ago, and had not yet been

repaired. We looked at a low sandy shore, along which a line of buildings stretched both right and left. Some of them are fine, but there was nothing to suggest the extent of town which lay behind. The sea was smooth, but we went ashore in one of the celebrated surf boats which can land in a sea that would upset and smash any ordinary European craft. They are very deep, with their sides high out of the water. The sides are tied with cocoa-nut fibre, and not a nail is used in their construction. Seats are placed in the stern for passengers, but the twelve rowers squat as best they can on the narrow bars or beams which stretch across the top of the boat. There are no stretchers, so the oarsman has to balance himself by the beam in front of him, which is at the same level as his own seat, and the oars are only long rough sticks, with a spade-shaped blade tied on to the end. The boat leaks badly even in smooth water, and altogether her looks belie her reputation for weatherly qualities.

We went to call on Mr. Pogson, who is in charge of the Government Observatory, and who issues notice of the approach of cyclones to ships in the roads. He told us that in his many years' experience the force of the wind had never been more than in a March gale in England, and that the greatest velocity registered by the instruments was only fifty-three miles an hour. The danger to ships lies in the heavy sea which breaks on shore; but as the wind in cyclones usually commences from the north-west, vessels can generally get well away from the land before they meet the full force of the hurricane. His daughter—

the meteorological reporter to the Government of Madras — is the first lady who has ever held a scientific post under an English administration. Her duties consist in the superintendence of the observers and observations which are taken in the Madras stations that report to the Meteorological Office of the Government of India. Her work is entirely independent of the Observatory, which is essentially astronomical, except so far as that the director is responsible for the issue of cyclone warnings; and it is said that everything is carried out in a most efficient manner.

Madras is a very uninteresting city. Even at this season, before the hot weather has set in, everything looks dry and parched; while in the middle of the day the crows stand with their beaks open as if gasping for air. The visitor traverses miles of irregular streets with little to attract the eye, or vary the monotony except a few public buildings; and the red dust settled on the leaves of the trees gives a dull dirty look to everything. A nearly vertical sun, shining out of an almost cloudless sky, fails to give that length of shadow which sometimes redeems an otherwise ugly form; and nothing relieves the glary sameness of shabby Oriental buildings.

The inhabitants, who are mostly Tamils, are very black and scantily clad, but when the boys dived into the sea out of the catamarans we could see that the soles of their feet and palms of their hands were nearly as white as those of an Englishman. This is a very ape-like peculiarity.

An easy run of three days carried us from our anchorage at Madras to our moorings in the Hooghly, below the city of Calcutta. A light south-westerly wind blew gently behind us, and an almost cloudless sky, prevented any observation on the upper currents, which would have been most valuable here. It was difficult to realise in this pleasant breeze and summer sky, the birth of a monsoon which within three months would deluge India with rain, and blow a fierce gale across the now tranquil Bay of Bengal.

The entrance to the Hooghly is like that of every other river delta. At first one can just discern through the white haze a low sandbank scarcely rising above the water; next the river narrows as the banks grow higher, and then the vegetation and life belonging to the climate gradually disclose themselves. Here we first see curious high stacks of rice straw, narrow below, and bulging out above like a balloon; then native boats of very peculiar shape, with enormous rudders worked from a platform above the stern. Higher up are straggling groups of native huts surrounded with bananas and palms of many kinds. Lastly, about seven hours after leaving Saugor Island, Calcutta came in view. A forest of masts, all belonging to big ships; a few domes and spires; low banks; a flat plain, with a cloudless sky and an air that felt as if it had come out of an oven, were our first impressions of the imperial city.

The low islands like Saugor at the mouth of the Hooghly have been the scene of some of the most

wholesale loss of life that has ever yet been recorded. We mentioned in our account of Mauritius hurricanes that a great tidal disturbance—*raz de marée*—and alteration of the sea level, were invariable accompaniments of those storms. There the sea is open, and the rocky islands of Mauritius and Bourbon both rise pretty steeply from the water, so the storm wave does little damage. In the Bay of Bengal it is very different. The coast on both sides converges into the delta of the Ganges; there the land rises by an almost imperceptible slope, and a tide of ten feet will cover nearly one hundred miles inland with water. So when the cyclones come in, as they always do, from about the south-east, the great wave which travels in front of them sweeps inland with irresistible force, and whole islands have been covered and absolutely depopulated in a single night. During one recent cyclone Saugor Island was thus swept; every human being, and all the cattle and tigers, were drowned, and in that single storm more than 100,000 people lost their lives.

The moorings of the Peninsular and Oriental Company are nearly two miles from the centre of Calcutta, so that on our first entrance we saw a good deal of the town. Calcutta certainly merits its name as the "City of Palaces." The large, if not lofty, buildings, the well-kept public gardens, and the Maidan or great open space for driving or walking, the numerous fine statues, and the many well-got-up equipages belonging evidently to persons of distinction, all give instinctively the air of an imperial city.

At the Great Eastern Hotel we are forcibly introduced to the most characteristic social features of Oriental life. Every guest must have a man of his own to perform the most trifling services; then two men have to be engaged to work the bedroom punkah, one by day, the other by night. As you walk down the wide passages of the hotel you find some of these men sitting or lying asleep till they are wanted; in fact no European does anything for himself, till at last the power of doing so is almost lost. Then there are the peculiar hours of meals. *Chota hazaree*, or small breakfast, at 6 A.M., then bath and walk or ride till nine o'clock, when breakfast is ready. From ten till four most men have to be in their offices, with a short interval for tiffin or lunch. After business hours, there is riding, driving, or lawn-tennis till dinner at half-past seven, after which most people retire tolerably early to rest. These hours are certainly well suited to the climate, but the habit of doing nothing for one's self is very prejudicial. All this strikes a traveller the more forcibly when he comes from a country like Australia, where personal service is scarcely to be got. We remember once asking a young successful New Zealand squatter, who was talking about the hares and pheasants on his estate, if he ever went out shooting. Well, he said, I could sometimes find the time, but when you have to carry all you shoot, you do not care to make a very big bag. How different it would be in India. A shikaree, or sportsman, would hardly go out without five attendants. One to carry his gun till wanted,

another the ammunition, and a third the dead game. Number four would be responsible for refreshments, while the fifth man would lead a pony to carry the sportsman from one cover to another. This certainly makes life very easy, but it is doubtful if the race gains thereby. The languor of the Tropics is only a sensation, and one which increases with indulgence. It is impossible to conceive a more unhealthy life than that of many European ladies in India, who lie on their couches all day and do absolutely nothing but think how hot it is and how ill they are. Lawn-tennis has had a most beneficial influence on the habits of Englishwomen in the Tropics; for the pleasure and excitement of the game compels them to take exercise, and to forget their ailments for a longer or shorter period.

One of our first visits was to the Meteorological Office in Russell Street, which contains two departments, that of the meteorological reporter to the Government of India and that of the reporter to the Government of Bengal. Recently the local government reporters all over India have been subordinated to the reporter to the Government of India, with the most beneficial results. Under the energetic supervision of Mr. H. F. Blanford, F.R.S., the whole of the observations in our Indian Empire are taken and published on a uniform system; and a rigid system of inspection of the instruments and observers at the various stations has been instituted every year. The levels of the different observatories are also all known through the great trigonometrical survey with the

greatest accuracy, while an abundant supply of cheap but efficient labour enables all the reductions to be checked in duplicate, and we doubt if any office can surpass in accuracy the observations which are published by the Indian Meteorological Bureau. Minute accuracy is of even more importance in the Tropics than in temperate climates. A fall in the barometer of 1-10th of an inch would be more ominous of danger in India than one of half an inch in Great Britain. The contrast too in coming from Australia is very striking. There, five different organisations take and publish observations in five different ways. Two are so disorganised as to be outside the sphere of criticism; the remaining three have each a competent and able superintendent at their respective capitals, but they are all so hampered by want of clerical labour, by the absence of grants for inspection, and the impossibility of getting the levels of some of the inland stations, that they are unable to bring their observations up to the standard they all wish to attain. Perhaps when the dream of a great Federal Australia has been realised some improvement may be possible; but in the meantime Australian forecasting suffers greatly, for there, as in India, very small differences of pressure mean a great deal when the probability of rain has to be considered.

At the time of our visit Mr. Blanford was absent on a tour of inspection, but Mr. A. Pedler, the acting reporter to the Government of Bengal, received us most kindly, and furnished us with a vast amount of valuable information as to the nature of day-to-day

weather in India, and of the cyclones which occasionally form in the Bay of Bengal.

That evening we had a specimen of a peculiar class of thunderstorm, which characterises the hot weather season in Calcutta and Lower Bengal. After a bright hot day (at this time rising to about 91° in the afternoon), with a few soft detached cumulus on a hazy blue sky, a great black sharp-edged segment of cloud rose gradually from the southern horizon about five o'clock in the afternoon. Gradually the dark pall crept overhead, and the clouds took a wilder form. Once for a few minutes some of the vapour developed a curious set of dark downward festoons; and we could see that while the wind blew from the south or east-south-east below, the higher clouds were driven by a west-south-west current. From six till seven o'clock rain fell irregularly, with moderate thunder and lightning; after which the weather cleared up for the remainder of the night. Mr. Blanford finds that these storms are formed by a conflict between the south-east sea breeze, which comes in about this hour, and the prevailing west or north-west winds of Upper Bengal.

Next morning Mr. Pedler took us to see the Alipore Observatory, about two miles outside Calcutta, where the observations for that city are taken, and the whole of the instruments for use in all India are verified previous to issue. What struck us most was the plain practical nature of all the instruments, and the absence of any fancy methods of doing the work. The two most noticeable features were the

thermometer stand, which has been adopted as a standard pattern for all India, and a remarkably simple and ingenious code for telegraphing up the daily observations to headquarters. The thermometer stand is really an oblong building consisting of a great sloping thatched roof, supported on eight or ten posts, the whole being about 20 feet long and 15 feet broad, and about 12 in height at the top. The eaves come down to within 5 feet of the ground, and the thermometers are fixed to a frame in the centre about 4 feet 6 inches above the earth. This arrangement certainly gives plenty ventilation, though the sun at rising and setting shines on to the ground inside the building; but the high price, ranging from £9 to £13, must prevent the adoption of this plan by any but richly-endowed organisations. The telegraphic code is the joint production of Messrs. Eliot and Pedler, who, within the limits of a small octavo pamphlet, have elaborated a code by means of which eight simple words suffice to convey to the central office the height of the barometer, the readings of the wet and dry bulb thermometers, the direction and force of the wind, with the weather and cloud, and a check number for the whole. On our return to Russell Street we saw the Alipore telegram arrive there. In much less time than it takes to write, the *Babu* in charge received and translated the message, applied the instrumental corrections and reductions, handed them to a second man to check, and filled up the report for the day.

Sometimes other things than climate have to be

considered in arranging meteorological instruments. At Alipore the black bulb thermometers, which are exposed to the full blaze of the sun, have to be protected from the crows by a kind of spiked cage; and the glass of a flat out-door mirror, which is used for observing clouds, has been cracked by those birds letting stones drop on to it.

The weather was now getting so hot that any attempt to see the many interesting cities in the plains of India would have been very trying, so we determined to give up all thought of visiting Benares, Agra, Delhi, etc., and to spend our time in the Himalayas. Another still more important reason was, that the clear skies which had followed us from Ceylon had effectually prevented any observations on the higher clouds, and there was every reason to hope that in the neighbourhood of a great mountain barrier, rising up to 29,000 feet, some indications of upper currents would be discovered.

We chose Darjeeling as our objective, both as offering the finest views in the Himalayas, and as being accessible in twenty-six hours from Calcutta. From two o'clock in the afternoon, till nine o'clock next morning, we travelled for 323 miles nearly due north across the level plain of Bengal. The country was a dead flat, sometimes a clayey soil broken into great gaping cracks by the sun; other times a dusty, sandy surface. Near Calcutta there were many barren stunted date-palms used for making toddy from the sweet sap; but beyond that district there was little vegetation to suggest the Tropics. Here

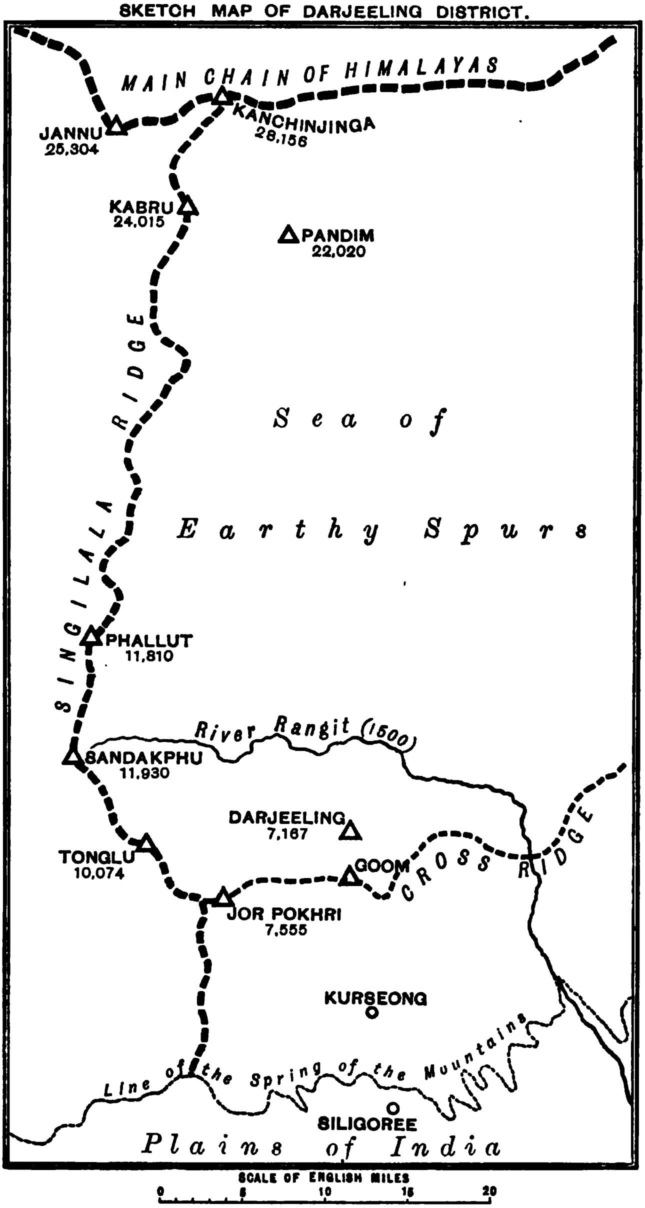
and there small brown villages were surrounded by a few bananas or clumps of bamboos; but the greater part of the land was cut up into small irregular cultivation plots, which now showed little trace of any crop. But though the sun was blazing overhead by day there was always a want of sharpness about his rays. A sort of hazy mist seemed to pervade the atmosphere, the blue of the sky was pale, and though the horizon was visible nothing looked clear or bright. The sun set as a red ball that might have been seen through a London fog; and the tints of the afterglow were pale and feeble. There can be no doubt that all this is due to a certain amount of fine earth dust in the air, and not to any condensed vapour floating about; for when we got up to 10,000 feet we could look down into the hazy plain with a hard dark sky above us. About ten miles from the foot of the hills we entered the deadly district known as the Terai. For some reason or other, all over India, and in many other tropical countries, the district at the foot, and on the first rise of the hills, is far more feverish than either the plains below or the hills above. It has been suggested that the land may be water-logged by springs from the hills, but even where rock crops out the country is equally unhealthy. In India this malarious belt runs the whole length of the Himalayas, and is no less dangerous to natives than to Europeans. Here the upper part of the belt, which is covered with forest, contains a few families of a very low tribe who never have fever in their own jungle, but who are usually attacked when they move to a different district.

From Calcutta to the foot of the hills, we only mounted 400 feet in 320 miles, but then the mountains begin suddenly, and rise for a distance of sixty miles in a low ascending series of earthy spurs to the main chain of the Himalaya. The lower hills are only 3000 or 4000 feet; by the time we get to Darjeeling, about fifteen miles in on a straight line, they have risen to 7000 or 8000 feet, and then they increase rapidly till the main chain of 20,000 to 24,000 feet is reached. Seven miles before reaching the foot of the hills, passengers are transferred from the ordinary railway into a two-foot steam tramway, which runs along the carriage road for fifty miles up to Darjeeling in about seven hours. The narrow gauge, and low-built carriages allow the trains to go round curves which would be impracticable on a larger scale; and in one or two places the line describes a complete corkscrew, of very small diameter. The windings of the railway are so great that the fifteen miles which separate Darjeeling from the foot of the hills have grown into more than forty miles of track by the time we arrive at our destination. Great care has been taken to make the gradient very uniform, and the little engine puffs away at the rate of seven miles an hour with the greatest regularity and sense of security. The road lies through dark forest most of the way, but there is little that is striking in the vegetation. At 4000 feet we came on a few shabby tree-ferns, but after Kurseong (4500 feet) some of the views looking down on to the tea-gardens in front, with the misty river-traversed plains in the

distance, were rather fine. When we got to Darjeeling (7200 feet) there was little promise of fine views; soft heavy clouds covered the sky, and a gray gloom seemed to combine the dust haze of the plains with the vaporous mist of a mountain district. Next day there was no improvement in the weather, though at nine o'clock in the morning the snowy peaks of Kanchin Jinga, Kabru, Jannu, and Pandim peeped out for a few minutes above the clouds. It appeared to us that the best chance of getting above the clouds and mist to see the mountains, and to observe anything was to go up 4000 or 5000 feet higher; so, on the advice of our friends, we determined to ride to a place called Sandakphu, forty miles off by road, and 12,000 feet above the sea, where there was a rest-bungalow with a view not only of Kanchin Jinga in front, but also of Mount Everest, the highest mountain in the world, to the far east.

The general scale of this portion of the Himalayas, the position of Darjeeling, and our line of march, will all be best understood by reference to the annexed map. There we see the two lines of the main chain of the Himalayas, and of the hill foot some sixty miles apart, the intervening space being filled by a sea of mountain spurs. Among this chaos of hills, one great spur, known as the Singilala Ridge, runs like a buttress from the main chain, through Kanchin Jinga and Kabru, right down to the plains. Phallut, Sandakphu, and Tonglu are three places on this ridge that are duly marked on the map. At Tonglu a cross ridge runs for many miles to the

SKETCH MAP OF DARJEELING DISTRICT.



eastwards. About fifteen miles, as the crow flies, along this from Tonglu, we come to the station of Goom, from which a spur projects northwards towards the mountains to the Rangit River. Five miles down this spur takes us to Darjeeling. A glance at the map shows how distant all these places are from the real mountains; but though they are so near the plains in a straight line, observe that at Sandakphu (12,000 feet) we have mounted nearly half the height of Kabru. As the crow flies, Kanchin Jinga is thirty-six miles distant from Phallut, forty-three from Sandakphu, and forty-six from both Tonglu and Darjeeling. The upshot of riding forty miles from Darjeeling along the road to Sandakphu was, that we found ourselves some twenty miles east of Darjeeling, only three miles nearer Kanchin Jinga, but on the top of a ridge which hides the view of Mount Everest from that place, and some 5000 feet higher.

The glory of this part of the Himalayas is Kanchin Jinga (28,000 feet), for long considered the highest mountain in the world, till displaced by Mount Everest. From every point of view it towers above its neighbours.

At Darjeeling one sees it flanked on the left by two saddle-topped mountains, Kabru (24,000 feet) and Jannu (25,000 feet); on the right by the pyramidal peak of Pandim (22,000 feet). These form a fine central mass, on either side of which the main chain stretches as a snowy sierra of rather monotonous character, with an average height of over 20,000 feet.

The general character of the sea of spurs that surround Darjeeling is very monotonous, consisting of great earthy hills on an enormous scale—10,000 or 11,000 feet on a single slope,—with huge V-shaped valleys, in whose narrow bottoms one can hardly discern a scanty stream. Near Darjeeling the lower portions of the hills are cleared and planted with tea-gardens, up which numerous zigzag paths lead to the various white bungalows. The remainder are covered with dense forests of a uniform dark green colour, and over all hangs a gray, monotonous, mysterious, magnifying mist. These earthy spurs are really composed of deeply weathered gneiss, but there is not a rock or cliff in sight to break the sameness of a soft soil, and of the uniformly-featured hills. At times when the snowy peaks peep above the clouds, the height of the great barrier which confronts you at a distance of fifty miles can be realised; and when, after marching for three days and finding that a single spur has only then been surmounted, you begin to gauge the size of mountains whose smallest ridges only can be attained.

It is impossible to see the Himalayas and not to compare them with the Alps. We were fortunate in having for a companion a well-known member of the Alpine Club, and in the main we both arrived at the same conclusion. In height, and in the appearance of a great mountain barrier the Himalayas are undoubtedly superior. From the Plain of Lombardy to Monte Rosa (14,000 feet) is about thirty miles, while

from the spring of the hills in the Terai to Kanchin Jinga (28,000 feet) is nearly sixty miles. We may say, then, roughly that the Alps are half the height and have half the base of the Himalayas. When we face the Himalayas there is a natural measuring-rod that enables us to grasp the significance of these abstract figures. The permanent snow-line of the southern slopes of the Indian mountains is about 16,000 feet, so if we look at the Himalayas, and mentally cut them down to their snow-line, the remainder would be nearly 1000 feet higher than the summit of Mont Blanc. The soft earthy spur on which we stand would be a mountain in Switzerland; and the lowest pass over the Himalayas is higher than the loftiest summit of the Alps.

But when we come to beauty, the Alps are immeasurably superior to the Himalayas; though we must remember only to compare panorama with panorama, and not a distant peep of the mountains of Thibet, with a near view of the cliffs and glaciers of Switzerland. Where do we see, in the gigantic monotony of the Himalayas, the view that meets us when we stand on one of the southern slopes of the Alps? Where is the strip of bright green meadow-land that fringes the rivers, and contrasts with the dark pines that clothe the lower mountain sides? Where are the rocky spurs, the lakes which reflect them, and the waterfalls that pour down their sides? Where are the picturesque chalets and the historical cities in the Plain of Lombardy? The mind instinctively admires what it can understand easily, and likes to see at a glance

the connection between the plain, the spur, and the mountain, instead of having to work out laboriously the relation of the huge earthy mountain on which you travel for days, to the great chain of which it is only a buttress. There is a comfort in compactness, and a prettiness in smallness, which must for ever make the Alps more attractive than the Himalayas.

CHAPTER XVI

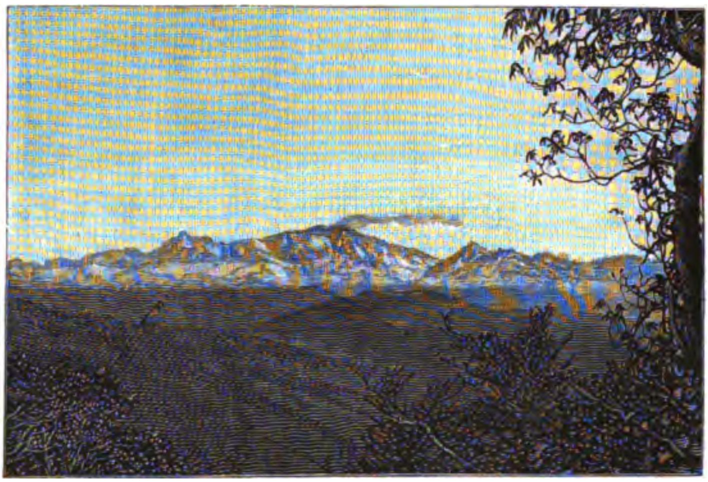
IN THE HILLS: THE BURST OF THE MONSOON

We left Darjeeling on the 9th of March for a week's marching in the hills. There is an admirably-kept road all the way from Darjeeling to Sandakphu and Phallut, with rest-bungalows at Jor Pokhri, Tonglu, and the above-mentioned stations. Only water and firewood are provided at these houses, and everything else has to be carried by coolies. We sent our party on to Tonglu overnight, with the intention of catching them up with our ponies next day, but when we got to Jor Pokhri, some thirteen miles out, the weather was so bad with thunder and rain that we preferred to remain there for the night. We saw nothing but mist and cloud all day, and after sunset heavy rain came on which lasted till eight o'clock the following morning. About half-way from Darjeeling we entered the dark rhododendron forest, not composed of shrubs as we know them in England, but of a large tree variety that will not grow at home. Every tree was clothed with dark green, hairy, drooping moss, which gave an appearance of unhealthiness and decay to everything. Here and there the white blossom of

an orchid showed on the moss without any leaf of its own, or with only an indication of its bulbous root; and occasionally a purple primrose grew by the roadside. Otherwise the undergrowth was featureless and uninteresting, and though any one glade of the forest was decidedly striking, the want of variety ended by making the view monotonous.

Next morning the weather did not look promising, for a heavy pall of cloud hid everything above 8000 feet, and fresh mist came rising up the valleys. However, we started for Tonglu, only ten miles off, but at an elevation of 10,074 feet. The scenery was exactly the same as yesterday, only at the higher levels some of the rhododendrons were in flower, with great scarlet or white blossoms. A month or six weeks later, when the whole forest is a blaze of colour, the effect is said to be splendid. We saw, however, a curious combination of orchids with snow, and rhododendrons with bamboo. At 7700 feet we got into the cloud level, while at 8000 feet we found snow on the ground which attained a depth of six inches at Tonglu. This increased the difficulty of going so much, that we took nearly five hours to arrive at our destination. In the afternoon there was a thunderstorm, with hail and lightning, which cleared and left a fine view of a great bank of cumulus lying parallel to the mountain chain, and completely hiding the peaks from our sight; while on the other side misty fog drove at times up the valleys from the plains. This fine driving mass of cloud, as it appeared when lighted up by the setting sun, with mist rising from

the valley, is given in the photograph, Plate VII. But alas, no picture can reproduce the lovely changing tints which made this one of the finest cloud effects I have ever witnessed. After dark there was another thunderstorm and more snow, but as the wind had got out of the south-east, and was now in the north-west, we went to bed with the hope that



CLOUD TRAILING FROM THE SUMMIT OF KANCHIN JINGA.

as usual there might be an extremely clear day when the bad weather had passed away.

In this we were not disappointed. Next morning, shortly before sunrise, we found that although an inch and a half of fresh snow had fallen on the ground during the night, a cloudless view of the great distant snowy chain and of the earthy spurs in the foreground opened before our eyes. In front rose the culminating triple peak of Kanchin Jinga; Kabru was now so foreshortened as to appear like a crag on the face of

Plate VII.

Clouds in the Himalayas

the greater mountain; to the left stretched the saddle-topped Jannu, far more imposing here than from Darjeeling; while on the right, pyramid-peaked Pandim completed the trio in the central mass. The engraving is reproduced from a photograph taken at the time.

Nearly half an hour before the sun got up, a bright segment of light, fringed by a rosy purple border, appeared above the eastern horizon, and cast a faint purple glow on the thin mist in the valleys, while the snowy peaks and ourselves were illuminated with a whitish light. This gradually died out, and a sheaf of pink diverging rays shot up from below the horizon around the morning star. Then all the pink and purple tints gave way to a yellow glow which pervaded mountain and valley alike. Opposite the sun a gray bank, shading through pink into the blue sky above, now appeared some height above the horizon, and ran round the horizon both ways, with an ever-decreasing depth, till it met the flare of the eastern sky. As the sun rose this gray bank descended, and when the coloured fringe touched the snowy peaks they became successively tinged with pink. The coloration began in the east and ran rapidly along the range, but was neither so vivid nor so prolonged as is usual in the Alps. In less than five minutes from the first touch of pink, the sun got up, and all colour rapidly disappeared.

The shorter duration of the pink colour is undoubtedly owing to the more rapid changes of a tropical twilight, while the paleness of the pink is

probably due to the greater clearness of the air at very high altitudes. All colour requires a certain amount of matter in the air to reflect it, and the pure air of the high Himalayas is not favourable to the diffusion of light, as we shall see presently from another point of view.

As there was now more than six inches of snow on the ground, and the fifteen miles of road to Sandakphu were very blind and steep, we determined to stay the day at Tonglu and study the topography of the mountains, and any meteorological peculiarities. We never lost sight of the snowy range all day. About 9 A.M. cumulus began to form in front of the mountains, and mist began to drive up from the southern valleys and obscured the peeps we got at intervals of broad white rivers wandering over the hazy plains of Bengal. The level of the base of the clouds rose and fell regularly with the day; and the different mountains served as so many measuring-rods to determine the height. At two o'clock in the afternoon the greatest altitude, 12,000 feet, seemed to have been attained; by 4 P.M. this had fallen to 10,000 feet; and three-quarters of an hour later to 8500 feet. After that the level did not appear to descend, but the clouds gradually disappeared. Late at night a little mist appeared in the low lands, but this was a fresh formation, not the clouds going to sleep in the valleys as is sometimes supposed.

During the day we were very much struck with the darkness of the blue sky overhead, and still more so when we examined the light with a spectroscope.

There was so little light in the pure sky that the spectrum was almost too dark to detect the solar lines, while in a small instrument there was no trace of atmospheric lines. The shading at the side of the "D" lines in the yellow, which gives a rough measure of the amount of uncondensed water-vapour in the air, was entirely absent, and so was the so-called "alpha" line, which probably measures in the same way the amount of condensed vapour or water dust in the atmosphere. When the slit of the instrument was turned on to the snow a brilliant spectrum flashed into view, which showed the solar lines far more clearly than usual at low levels. This, of course, explains what has been so often remarked, that in Alpine photographs the skies are much blacker than the snows, or even parts of the landscape. There is not enough material in the clear air to reflect or diffuse as much light as would be sent back directly by ordinary objects in full sunshine.

When the sun got up the glare from the newly-fallen snow was blinding. The coolies blackened all round their eyes with charcoal, and asserted that this saved them from injury. The Thibetans use spectacles of horse hair to protect their eyes from snow-blindness in the high passes, but this blackening the skin to relieve glare suggests some curious questions. The practice of using a black smear to protect the body from the sun's glare is found in many countries and under very different conditions.

All over the north of Africa the eyes are frequently blackened to palliate the intense heat and

light reflected from the sandy desert. In Fiji we have already described how the natives, who are in the habit of daubing themselves with coloured clay by way of ornament, select black both for the faces and limbs when they go fishing in the sun, and here in the Sikkim hills we again find black used to prevent snow-blindness. We tried some experiments on it ourselves. The first day we had one eye blacked native fashion, the other left natural, and then walked for half an hour in the sun, but did not find much difference. The next day we blacked both eyes as we marched to Sandakphu, but were very glad when the mist came up and obscured the sun. Still it is impossible to suppose that three widely separated races should use black to palliate three kinds of solar reflection if that colour had not some special protective influence. But then here is one of the strange anomalies in which physiological experience contradicts the teachings of pure physics. Charcoal black is used in all physical experiments as the best absorbent known for all qualities of radiant heat, yet this very substance is employed by at least three races to protect themselves from that very kind of heat. Perhaps when the explanation of this has been discovered we may be nearer the solution of a problem which has always puzzled the anthropologists—why races near the Equator are black? The sun, no doubt, darkens the skin, but if black, as is supposed, is the best absorbent of light and heat, natural selection should have developed a white race on the Equator as best adapted to withstand the climate. At present

we cannot even offer a suggestion, so we must be content with a statement of facts, and hope that future research may give a clue to the mystery.[1]

All day a small strip of cumulus streamed from the peaks of Kanchin Jinga, and served as a wind-vane to show us that the wind at that height did not differ materially in direction from that at Tonglu. The very fact of the cloud being there was also interesting, as proving that cumulus can exist up to 30,000 feet, which has been denied by some meteorologists. (See engraving, p. 286.)

Later on in the day, at about a quarter before 6 P.M., a patch of pearly white light formed in the sky about 15° above the sun; and soon afterwards we could see the long shadow of Tonglu stretching up to Darjeeling, and on to the thin mist over the Ranjit River, while the streamer from Kanchin Jinga, a line of cumulus parallel to the main chain, and the snowy peaks which showed at intervals, were all bathed in a glow of sunset colour, save where the gray shadows of the clouds were projected upon the mountains. Ten minutes later, just after sundown, the pink began to tinge the eastern peaks, and ran rapidly westwards along the chain, sometimes touching, out of its turn as it were, some mountain summit whose greater height caught the rosy shadow sooner than its humbler neighbours. Soon this passed, and the pearly light over the sun was replaced by a purple

[1] For some curious observations on the effect of freckles as palliative of sunburn, see a letter by Dr. R. H. Bowles, *Nature*, 31st May 1888.

patch which gave the first afterglow, while the rosy arc which had tinted the mountains could now be seen faintly in the air above their highest summits.[1] The sky on either side of the purple became lavender coloured, and by degrees the purple grew into the most lovely violet we have ever seen at sunset. Gradually the colour faded where it was—it did not set like the sun—and left a beautiful starlight night with a bright moon lighting up the cold, pale, gray peaks of Kanchin Jinga.

Next day we marched to Sandakphu. The road which here follows the frontier between British Sikkim and the Nepaul Territory has been laid out with great care and with moderate gradients. It is, however, a curious thing that, here as elsewhere in the Himalayas, the men who carry heavy loads never follow the smooth zigzags of the European engineers, but always some rough, steep "coolie path" that goes straight up and down hill, and often requires each footstep to be carefully chosen. The glare at starting was tremendous, for an almost tropical sun sends back a very fierce reflection from newly-fallen snow. Fortunately about 9 A.M. a thunderstorm on the spurs below us sent up enough mist to obscure the sun, and later cumulus formed just as on the day before, only a little denser in structure. At sunrise we had another splendid view of the snowy range and of Kanchin Jinga with its trailing cumulus; but the clouds which formed later on did not fall towards evening so de-

[1] This rosy arc is the fringe of the gray shadow of the earth, which forms the anticrepuscular arch (*v.* p. 50).

cidedly as the previous day, and when we arrived at Sandakphu, nearly 12,000 feet, the mountains were all enveloped in cloud which lasted till after dark. At 11,000 feet we came to the first pines, which were of the silver fir tribe, with an undergrowth of wormwood, and bamboo thickets all about. It was very cold when we arrived, and the thermometer under the verandah fell to 21° during the night; still our coolies all walked barefooted, and did not seem to be the least inconvenienced.

In the morning we had a view that well repaid us for our trouble. A splendid wall of snowy mountains stood up in front of us for nearly 300 miles. On the extreme right the mountains of Assam; then the one high cone of Chuma-la-ri (Chuma Pass Mountain), from which a uniform sierra of peaks, like the teeth of a saw, ran up to the great group of Kanchin Jinga, which we had seen from Tonglu; then another long sierra stretched to the left, till ninety miles off the eye was caught by three great peaks in the distance. The centre of these, though not apparently the highest, is Mount Everest, 29,002 feet, the loftiest mountain in the world; a nameless peak on its right attains 27,800 feet, while the left-hand supporter, though equally grand, is both unnamed and unmeasured. From these giants the chain proceeds as far as the eye can reach, far through the little known territory of Nepaul. This is undoubtedly the finest panorama of snowy mountains in the world. There are only three great chains—the Alps, the Andes, and the Himalayas. All travellers agree that the forms of the Andes and their

general aspect is inferior to the Alps; and we have already shown how the Himalayas surpass the Alps in size, though they only take the second place in respect to beauty.

It is impossible to look at the Himalayas and not be struck by the apparent thinness of their snows. We miss the vast snow-fields of the Alps and the great development of glaciers running far down into the green forests. We must find the explanation of this partly in the rugged character of the southern face of the Himalayas, partly in a rather scanty snowfall and in the excessive dryness of very high altitudes. On the northern side of the Himalayas these conditions are so much more pronounced that the level of perpetual snow rises from 16,000 to 18,000 feet, and no glaciers whatever can form. In this we find a curious contrast to the Alpine ranges, where the snow-line is a good deal lower on the northern than on the southern side. In the Himalayas, on the contrary, the quantity of snow precipitated on the southern slopes is so much greater than that which falls on the side of Thibet, that even an Indian sun cannot raise the level of perpetual snow to within 2000 feet of the line on the northern side.

Nearly all the snow on the Himalayas falls during the winter months, during the north-east monsoon, when small secondary cyclones form in Afghanistan or the Punjab, and skirt along the foot of the hills, bringing the winter rains on the plains of Northern India and abundant snow on the mountains. During

the great rainy season, when the south-west monsoon deluges the plains of Bengal, the Himalayas receive but an insignificant snowfall.

The homeward march was along precisely the same route as before, so that there was more time to take our eyes off the mountains, and study the people met along the road.

The mixture of races which one sees at Darjeeling is very great. The most interesting people, and far the strongest, are the Bhoteas from Bhotan. They are of fair height, very strongly built, with broad, bright-complexioned faces. Socially they are polyandrists, for custom gives four husbands to each woman. It used to be thought that infanticide of female children brought the numbers of men into undue proportion to the female population, but the most accurate statistics at present procurable seem to prove that an enormous excess of male infants are really born. Anyhow, their smiling, pleasant faces and well-filled limbs are an agreeable contrast to the pale, melancholy Lepcha, whose slight figure and oblique eye show some relation to the Chinese race. These Lepchas are probably the most ancient inhabitants of Sikkim, but are now dying out fast. The race which is rapidly replacing them is the Nepaulese, —stout, sturdy little men, of Mongolian aspect, who swarm over the frontier to find employment in the tea-gardens, and protection from native oppression under the just rule of the British Government.

As the traveller goes along the road he will be struck by seeing slips of paper covered with writing

hanging on the top of bamboos and waving in the wind. These are prayers, the exhibition of which in this way is supposed to be as efficacious as verbal repetition. A still more curious phase of religious rite is seen in the praying wheel. Its simplest form is a small brass cylinder with the mystic Buddhist invocation—*Oom mani padmi om*—embossed on the metal, and filled inside with written prayers on paper, which is turned round a small stick held in the hand. In the temples a large wheel six or eight feet high is conveniently mounted for the faithful to revolve by hand; each turn is equivalent to saying the prayer once. A still more elaborate arrangement is sometimes found where the praying cylinder is worked by water power, so that the invocation goes on perpetually by night and by day.

On our return to Calcutta I was fortunate enough to find that Mr. H. F. Blandford, the meteorological reporter to the Government of India, had returned from a long tour of inspection. We talked on the nature of weather changes from day to day in India, and also of the great event in the climatic year—the burst of the south-west monsoon. The latter is of peculiar interest to meteorologists, for there is a great deal connected with it which cannot at present be explained. Over the greater part of India a drought of about two months' duration is suddenly broken up by a violent outburst of thunder and rain, which continues for two or three months; but the weather charts show little change, and the isobar lines of equal pressure that guide us unerringly through the

most complex phenomena of a cyclone appear to fail completely here. The following graphic description of the burst of the monsoon in Ceylon is extracted from Sir E. Tennant's well-known work on that island:—

"Long before the wished-for period arrives, the verdure produced by the previous rains becomes almost obliterated by the burning droughts of March and April. The deciduous trees shed their foliage, the plants cease to put forth fresh leaves, and all vegetable life languishes under the unwholesome heat. The grass withers on the baked and cloven earth, and red dust settles on the branches and thirsty brushwood. The insects, deprived of their accustomed food, disappear underground or hide themselves beneath the decaying bark. Butterflies are no longer seen hovering over the flowers; the birds appear fewer and less joyous; and the wild animals and crocodiles, driven by the drought from their accustomed retreats, wander through the jungle, and even venture to approach the village wells in search of water. Man equally languishes under the general exhaustion, ordinary exertion becomes distasteful, and the native Singhalese, although inured to the climate, move with lassitude and reluctance.

"Meanwhile the air becomes loaded to saturation with aqueous vapour drawn up by the augmented force of evaporation acting vigorously over land and sea; the sky, instead of its brilliant blue, assumes the sullen tint of lead, and not a breath disturbs the motionless rest of the clouds that hang on the lower

ranges of hills. At length, generally about the middle of May, but frequently earlier, the sultry suspense is broken by the arrival of the wished-for change. As the monsoon draws near the days become more overcast and hot, banks of cloud rise over the ocean to the west, and in the peculiar twilight the eye is attracted by the unusual whiteness of the sea-birds that sweep along the strand to seize objects flung on shore by the rising surf.

"At last the sudden lightnings flash among the hills, and sheet through the clouds that overhang the sea, and with a crash of thunder the monsoon bursts over the thirsty land, not in showers or partial torrents, but in a wide deluge, that in the course of a few hours overtops the river banks, and spreads in inundations over every level plain.

"All the phenomena of this explosion are stupendous; thunder as we are accustomed to be awed by it in Europe affords but the faintest idea of its overpowering grandeur in Ceylon. The rain at these periods excites the astonishment of a European. It descends in almost continuous streams, so close and so dense that the level ground, unable to absorb it sufficiently fast, is covered with one uniform sheet of water, and down the sides of acclivities it rushes in a volume that wears channels in the surface.

"This violence, however, seldom lasts more than an hour or two, and gradually abates after intermittent paroxysms, and a serenely clear sky supervenes. For some days heavy showers continue to fall at

intervals in the forenoon; and the evenings which follow are embellished by sunsets of the most gorgeous splendour, lighting the fragments of clouds that survive the recent storm."

Nothing can be more obvious than that some great change takes place as the monsoon bursts, but what is it? So early as the latter part of January, southerly winds set in on the coast of Bengal as afternoon sea-breezes; in the following months with the rise of temperature they become more prolonged. We have already described the lovely weather which we experienced with light south-westerly winds as we sailed up the Bay of Bengal during the early days of March. Why does the monsoon which begins like a lamb go out like a lion?

All the daily charts tell us is, that from about February a persistent depression of the barometer lies over the top of the Bay of Bengal; as this gradually gets larger and deeper the south-west wind creeps slowly down the coast till it gets to Ceylon about the beginning of June. Then with no apparent change on the charts, or in the direction of the wind, rain comes on with a burst in Ceylon, and gradually works up the west coast to above Bombay, and up the Burmese coast till all Bengal is involved. Madras escapes for the present, only to be deluged in September. After Ceylon we next hear of rain at Diamond Point, near the mouth of the Irrawaddy; soon Assam is involved, and the monsoon usually reaches Calcutta four days after it has burst over Bombay on the other side. Thus we see that the wind works down

the coast while the rain works upwards; and here we have the explanation of an apparent discrepancy between various writers. Some, like Maury, talk of the monsoon gradually extending its sphere from the northwards, while most others, and all current talk, speculate on the number of days which the burst of rain takes to travel from Colombo to Bombay. Both are correct. All depends on what definition we adopt for the word monsoon. If by that we mean the commencement of a certain wind the former statement is strictly accurate; if we imply the setting-in of rain, the latter equally describes the facts of the case. The only difference that can be seen in the daily charts is that the depression is a little deeper, the isobars a little more distorted, and that its centre has moved a little up the Ganges valley; and we can also note that the character of the rain is totally different from that of cyclone rain. The Indian meteorologists are of opinion that this burst of the monsoon is due to the sudden invasion of India by a stream of wind drawn from a reservoir of saturated air in the doldrums; but that the south-east trade is not linked up with the south-west monsoon in a continuous current except occasionally and temporarily. The south-east trade sweeps across the Equator in the Arabian Sea as a broad steady current, and turns gradually to the south-west and west. But it is very different over the Bay of Bengal. A ship going up to Calcutta finds the south-east trade die away on the Equator; she then experiences variable winds from south to west, with rain and squalls for about 10° north, and

finally runs up to the bay before a strong south-west monsoon, without excessive rainfall.

It is evident, then, that there is some hitch in the flow of the trade across the Equator; but the reason cannot be discussed here. It can only be remarked that as regards the sudden commencement of rain over Bengal, we have here on a great scale what puzzles all European forecasters. In a cyclone they can locate the position, if not the quantity, of rain pretty accurately by looking at the isobars, but there is a large class of rainfalls usually associated with thunderstorms, for which they can neither assign a position nor indicate the amount. In every case—European or Indian—the isobars rarely fail to indicate both the direction and speed of the wind; but in non-cyclonic rainfalls such as these they totally fail, and meteorologists have yet much to learn as to the true nature of the burst of the monsoon.

CHAPTER XVII

BORNEO: THE EVOLUTION OF KISSING

We left Calcutta on the 19th of March 1885 *en route* for Singapore and Borneo. Very fine weather was experienced in the upper part of the Bay of Bengal, with a sharp horizon, and the usual small detached cumulus of the Tropics. The mysterious zodiacal light was seen in great perfection on the night of the 22d. Astronomers have long been puzzled to decide whether this appearance belongs to the earth's atmosphere, or whether the glow is an appendage of the sun.

About an hour and a quarter after sunset, when the twilight was quite gone, a long narrow cone of light, rather brighter than the Milky Way, was seen lying on the sky obliquely to the horizon, up to a height of at least 20°. The slant of the cone followed the line of the zodiac among the stars, and the whole appearance seemed to set at the same rate as the other heavenly bodies. Small stars could not be seen through the zodiacal light so clearly as in the rest of the sky, even with the aid of a field-glass. The different theories of the light cannot of course be discussed here; but it is perfectly certain that if the

Plate VIII.

Pikes Peak, Colorado

cause of glow is terrestrial, it has nothing to do with the ordinary phenomena of sunset.

As Penang was approached the air grew much more hazy and vaporous, while the sky and clouds became dirty and ill-defined. Off Malacca, on the day when the ship passed under the sun, there were several showers, with thunder and lightning, but no wind; and at Singapore we saw a halo round the sun at two o'clock in the afternoon. This latter is not a very common appearance so near the Equator.

Penang is reported to be healthy, but is very hot and close. A mountain 3000 or 4000 feet high forms the centre of the island, and as the town is built on the eastern side, the north-east monsoon is arrested by the land to leeward, and leaves the city hot and airless. Singapore, on the contrary, where our ship arrived after a thirty hours' run from Penang, is on a low island, so that the wind blows easily over the land. Between the land and sea breeze there is always a pleasant air going, and considering that the town is only eighty miles north of the line, Singapore is one of the healthiest places in the Tropics. No fever prevails there as in Batavia and other places not far off; but of course Europeans cannot escape the debilitating influence of a hot, damp, winterless climate. There are very few rosy cheeks in Singapore. Curiously enough, the neighbouring territory of Johore, on the mainland, is very unhealthy from fever; and still more deadly is the adjacent island of Sumatra, where the Dutch troops die like sheep from *beri-beri* before the fortifications of Acheen.

At Singapore the traveller enters a new and peculiar world, which is confined to the Malay Archipelago, or Malaysia, as it is sometimes called. Among these islands he sees many types of mankind and phases of nature which are found exclusively in this region. Here alone he finds the Malay race in its purity, with its true characteristics of mind and feature, though the language has extended among other nations to Madagascar on one side, and to Tahiti on the other. Here, too, he sees races who use strange weapons, like the *sumpitan*, through which they blow light darts poisoned with the juice of the deadly upas tree; and in Sumatra and Borneo only is found the semi-human ape, the orang-outang, living among the tree-tops of the great forests. Nowhere else do swifts build their gelatinous nests, so prized by Chinese epicures, and which are gathered by the jungle men from dark caves with ladders 200 feet long.

The vegetable kingdom of Malaysia is still more unique. Among its peculiar products are the luscious mangostene,—which has no connection with the widely distributed mango,—and the strange durrian, which smells like bad drains, but is such good eating that when once the taste has been acquired no fruit is deemed so delicious. The products of the Spice Islands are proverbial—the nutmeg, the mace, and the clove; and perhaps less well known are the white scent-producing flowers of the fragrant ylang-ylang. More useful to the world are the pith of the sago and stem of the rattan palms; and not less valuable to the native the leaves of the *nipa* palm, which grow out

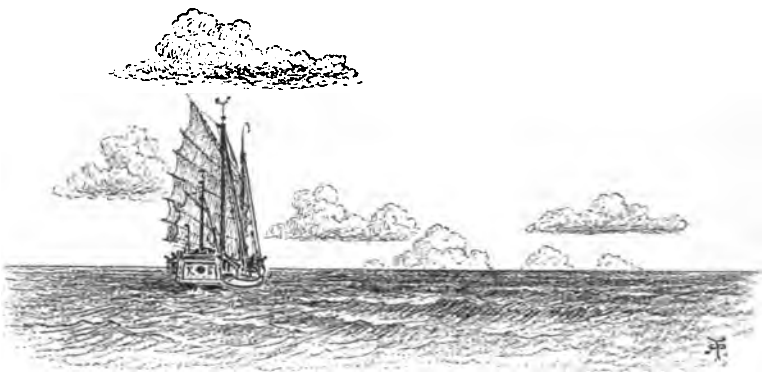
of brackish water, and constitute one of the most peculiar features in the river scenery of the Malay Archipelago. Beautiful, if not useful, are the rare orchids which grow among the tree-tops of the forests of Borneo, and strange nepenthes whose leaves form pitchers to entrap unwary insects. In the deep jungle medicine men collect the juice of the upas tree,—whose poisonous qualities have been so much exaggerated,—and the sap of the creeping *bima*, without which the upas loses half its value.

The climate of this district does not present such striking meteorological features as the burst of the monsoon in Ceylon, or the cyclones in the Bay of Bengal. Still these islands were interesting as affording a simple study of truly equatorial climate, undisturbed by violent paroxysms of wind. The seasonal changes are also transitional between those of the Indian Ocean and the simple weather system of the Pacific.

We started from Singapore in the S.S. *Paknam* for the territory of the North Borneo Company, by way of Labuan. Two days out, while passing through the Natunas Islands, I saw one of those beautiful effects of distant clouds which are rarely seen out of the Tropics. The horizon was so sharp and clear that the firm detached cumuli could be seen sinking below the sea like a ship whose hull disappears in the distance before her topsails. In England a cumulus cloud is usually lost in haze long before its base reaches the horizon, but here we saw clouds in every stage of disappearance. First the flat bases

just touching the water, then the half-hidden mass of cloud, and lastly the knobs of condensed vapour which formed their summits just peeping above the horizon.

It has been stated that when clouds can be seen like this it is a sign of calm in the direction where they are observed. In this case, though not going in the direction of the clouds, the ship fell in with an oily calm some hours later; but on several other occasions I have seen this appearance with a light



CLOUDS SETTING BELOW THE HORIZON.

breeze which did not die away. At the same time I have never seen these sinking clouds in anything like bad weather, and believe that, if not indicative of absolute calm, they are at all events associated with light wind and very fine weather.

On the fourth day after leaving Singapore we steamed into the harbour of the island of Labuan, and remained there for two days. Labuan is a small low island, now quite cleared of primary jungle, and since the stoppage of the coal mines the place is decaying fast.

The climate of Labuan is a most pronounced specimen of that tropical type, in which the greater portion of the rain falls by night and not by day. Here an average of 140 inches of rain is gauged every year, and the greater portion of this is precipitated during the dark hours of the night. The local explanation of the night fall is, that the land wind from Borneo—only six miles distant—blows the clouds from the mountains of that island on to Labuan in the form of rain. Whether this is absolutely correct we cannot say, for it did not rain either of the nights we were there, and the question of day and night rain is too complicated to be discussed here. Some very heavy rainfalls are reported both from Labuan and Borneo. For instance, Sarawak on the mainland has an average of 180 inches of rain *per annum*, and as much as 15, 16, and 14 inches on three consecutive days has been gauged.

From Labuan an easy steam of ten hours brought us to the island of Gaya off the coast of Borneo—the first station of the British North Borneo Company.

This semi-independent Company is trying a very interesting experiment in their attempt to make money by a combination of the powers of a government with the profits of a land company. The Company has obtained a concession of the land of all North Borneo from the Sultans of Brunei (Borneo) and Sooloo, on payment of a certain rent or tribute. Though it holds a charter of incorporation from the British Government,—which provides amongst other things that the territory may not be ceded to any

other country without the consent of the Foreign Office,—the Company exercises all the functions of a sovereign state. It makes its own laws, imposes its own taxes, keeps up a small army of 200 men, and a navy if need be, without that reference home which is necessary even in free colonies like Australia. The policy of the Company is not to trade like the old East India Company, which began as an association of mercantile adventurers and ended with enormous sovereign rights, but to make a settled government in a wild country, take what profits, customs, excise, fines, etc., may bring in, and then develop its territory for plantation or settlement like the great land companies of Australia or North America. Borneo has already been the field of one somewhat similar experiment in the establishment of an independent rajah at Sarawak. The late Rajah Brooke sunk the whole of his private fortune—at least £20,000—in that enterprise. His successor passes about £5000 a year out of the revenues of the country to his private purse, and there is an abundant margin to maintain a liberal administration. Then of course we must allow for an element of personal power. A rajah thinks of position and private gratification, while the North Borneo Company has only to think of shareholders and dividend. Time will show which system works best, for no personal government has ever lasted more than a few generations.

So far—in five years—the Company has not been a financial success, and from the nature of circumstances could not be so; but the increasing revenue

is now so rapidly approaching the expenditure, that within a year or two equilibrium will have been established, and then dividends may soon be expected.[1] Those who know the time that it takes to develop a land company amid the difficulties which beset enterprise in a new country like Australia or Canada, where there is already a settled Government, capital ready for investment at known risks, and the example of similar successful speculations, will not wonder that Borneo—a mere jungle with no settled government, inhabited by wild tribes, and without roads or harbours—should either take a long time to open out, or fail readily to attract outside capital.

The general aspect of the coast of Borneo and of the Company's settlements is very uniform. On first approaching the land you sée only a dark jungle-covered country rising gradually in successive ridges up to mountains in the interior. Coming still nearer you probably notice a *kilong* or line of stakes standing in the sea 300 or 400 yards from shore. This is a native fish trap, and not far from it you will see projecting from the mangroves which fringe the shore that small group of houses, built on piles over the sea, which constitutes a Bornean village. Sometimes the houses are entirely cut off from the land, and all communication has to be in boats; but in most cases a footplank called a *jimbatun* enables the inhabitants to walk on shore.

These pile dwellings are of special interest to the anthropologist, as they reproduce the leading feature

[1] This equilibrium has now—July 1888—been attained.

of the lake dwellings in Switzerland and *crannogs* of Scotland. Piles seem to have been selected partly for protection from wild beasts and robbers, partly for sanitary reasons. When we find them on a coast it may be presumed that the sea is never very rough, or at least that the shore is protected by a reef or bar. This engraving is a typical specimen of a pile dwelling

PILE DWELLING, BORNEO.

from a photograph taken in Sandakan Bay. The bushes on the left of the picture are mangroves; while the ladder nearer the centre is used for getting into boats.

The coast tribes are called Bajows, and seem to be of Malay origin. Formerly they were pirates, but now, under the rule of the Company, are peaceable traders.

Wherever a European settlement has been formed,

a semi-circular patch has been cut out of the jungle. From the centre of this clearing, a pier runs out into the sea, and on either side—mostly over the former line of mangroves—a busy Chinese bazaar has sprung up. The Resident's house and office are usually detached bungalows a little way up the hill; and a few other houses complete the somewhat straggling station. Overhead appears a whitish-blue sky, with heavy cumulus clouds over the land; while the distant mountains are obscured by the hot steamy air. Such is the picture of Borneo in the dry month of April.

We landed at Gaya to see the Bajow pile-village, and some Dusun salt pans. This was our first introduction to the stench of a mangrove swamp which is so fatal to Europeans in Africa. Everything about the tree seems deadly, even the oysters which attach themselves to the roots are dangerous to eat, and to sleep in the swamp is certain fever. Wherever mangroves are seen, languor and sickness are invariably associated with their noxious presence.

We had great difficulty in prevailing on some Dusuns to be photographed; they said they should be bewitched. However, the persuasions of Mr. Little, the Resident at Mitford, backed by the sight of a dollar, eventually overcame their scruples.

The native policy of the Company is very successful, and forms a pleasant contrast to the Spanish rule in Sooloo and the Philippines. There is scarcely a district in the territory of British North Borneo in which a white man cannot travel in safety, and the

same may be said of Sarawak. In Sooloo, on the contrary, and in many parts of Mindanao, no Spaniard can leave the walls of the towns without being killed by the natives.

From Gaya, two days' sail took us to Sandakan, the capital of North Borneo, where I spent a fortnight under the hospitable roof of Governor and Mrs. Treacher. There I not only had the opportunity and leisure for making careful observations on various points of tropical weather, which could not be done at sea, but through their kindness and that of other officers of the Company, I was able to see all that was most characteristic of man and nature in Borneo.

Being now the middle of April, the north-east monsoon was dying out, and the south-west monsoon was gradually taking its place, for there is no "burst of the monsoon" here as in Ceylon. At Sandakan a south-west land breeze generally set in, very light, about 3 or 4 A.M., sometimes associated with a little rain. As the sun got up the breeze increased in strength, but was always moderate. About noon the wind went round by south-east to north-east, and continued in that quarter till 3 next morning. The high upper clouds invariably came from about north-east. At sunrise the sky was generally partially covered with irregular stratus and cumulus, while later on masses of soft cumulus floated in a whitish-blue sky, and the distance was usually hazy from the steamy air. About noon, just as the sea breeze was coming in, we used to see a heavy bank of cloud to the north-east, and this moved slowly along the south side

of the bay, till by 5 P.M. it had nearly disappeared in the south-east. Thunder frequently grumbled among these clouds during the afternoon, and occasionally a few drops of rain seemed to reach Sandakan. This daily storm, like the rain in the early morning, was certainly due to the conflict between the land and sea breezes, and is one of the commonest phases of tropical weather. Very striking cloud masses were usually

CLOUDS OVER A THUNDERSTORM, BORNEO.

formed over this storm. The illustration, engraved from a photograph, shows especially the peculiar hairy structure which is very characteristic of heavy rain. Occasionally showers fell at uncertain hours which had nothing to do with the regular daily sequence of weather. About sunset the rocky clouds became flatter or more stratiform in appearance and diminished considerably in quantity. The night cloud varied very much in character, but was generally much less in quantity than during the day. In our bedroom the

thermometer used to range pretty steadily from about 78° to 84° or 86°, and the wet bulb temperature of evaporation never fell below 77·5°.

I thought at first that the canvas bags that are universally used in Australia for cooling water by evaporation would be useful in Sandakan, where there is no ice machine. But when I saw the temperature of evaporating wet muslin, as shown by the wet bulb thermometer, it was evident that even in a windy place the lowering of temperature would be very small in such a damp climate as Borneo.

The success of the bag full of water depends on the liquid which slowly oozes through the canvas being evaporated so quickly that the temperature is appreciably lowered. The rate of evaporation depends chiefly on the dryness of the air, and to a less extent on the amount of wind. Here the temperature of evaporation, as shown by the wet bulb thermometer, never fell below 77°, while in the dry climate of Australia the depression might have been down to 65°, or even lower. As an extreme case, Mr. Wragge once found the wet bulb in Adelaide marking 69°, while the dry thermometer stood at 105°. In Borneo no such evaporation, and therefore no such cold, is possible.

The climate of Borneo is essentially and typically equatorial. We have just described the sequence of a day in the dry season; in the wet months the changes during each day would be different.

The course of the seasons is practically the same on both sides of the island; at Sandakan on the

east coast, as at Papar on the west coast. Borneo presents a great contrast in this respect to the Philippines. There, as in Ceylon, the wet season is on that side of the island which first catches the monsoon; that is to say, the east coast has its wet season during the north-east monsoon, and the west coast its wet weather during the south-west monsoon, so that one coast enjoys fine weather while the other is deluged. In Borneo, on the contrary, both coasts have two rainy seasons—the great rains and the little rains. For instance, taking Kudat as the centre of the territory, the great rains begin at the end of October and last till January, that is to say, the commencement of the north-east monsoon is wet. The little rains are rather irregular in their appearance, but always come some time between May and August, or at the commencement of the south-west monsoon. At Papar, down the coast, the great rains begin and end a month earlier than at Kudat. The north-east monsoon is by far the strongest here, the south-west monsoon being very irregular. This is the reverse of what happens in India. The total amount of rainfall on the coast stations in North Borneo is about 120 inches a year, but inland, on the mountain slopes, the amount is probably much larger.

The words "rainy season" often convey a very erroneous impression to Englishmen; they sometimes think that it rains all and every day during that time. No doubt in the Tropics it sometimes rains for two or three days without stopping, or there may be a month with twenty-eight or twenty-nine rainy days; but in

the former case there are always so-called "breaks in the rains," or a day or two of tolerably fine weather; and in the latter the rainfall is in showers and not continuous.

But in spite of the reversal in the direction of the wind during the two monsoons the temperature never varies much either during any one day, or from one day to another, or in the different seasons. At Sandakan the greatest recorded range of temperature on any single day is about 24°, while the least is 7·5°, and the average for the whole year amounts to hardly 15°. This uniformity and equable nature of all weather changes is the great peculiarity of truly equatorial as opposed to a merely tropical climate. In many parts of India, such as Allahabad, the temperature on any one day may range through 54°, while the mean range for the whole year is nearly 24°.

Such contradictory accounts of the healthiness of the climate of North Borneo had been circulated that we made careful inquiries on the subject. On the whole, the country appears to be fairly healthy for the Tropics, less so perhaps than Singapore, but much better than the Dutch islands south of the Equator. There is certainly a good deal of intermittent fever about, and a great many visitors to the island are attacked; but the type of the disease is not severe, and Europeans rarely succumb to its effects. There was only one case of intermittent fever at Sandakan, out of a community of about twenty-five Europeans, during the three weeks we spent on the island; while in the four years that the Company have had posses-

sion of the territory, only one death has occurred from fever among their European staff, and that was a man whose constitution was already ruined. Moreover, there is very little diarrhœa or dysentery, boils and sores are not particularly hard to close as in Fiji, and we never heard of ophthalmia. On the other hand, the debilitating influence of a steamy greenhouse heat and of a winterless climate is more or less felt by everybody, but not to the same extent as at Panama and in some other places.

One evening the Governor arranged for a Dyak war-dance by moonlight. Several of the men were old Dyak head hunters who are now serving in the military police of the North Borneo Company. The performers were but slightly clad, for a turban or a head-dress of woven rattan with tail feathers of the Argus pheasant as a plume, a narrow cloth round the waist and passed between the legs, with a small mat hanging behind to about eighteen inches below the waistcloth, completed the costume (see engraving). Some had a garter of fibre bound round the bare leg between the knee and the calf, but this was only for ornament, and not as a support to the muscles. Music was supplied by eight small gongs, harmonically tuned, and by a drum on which the player sat and beat the sides with his fingers. Two planks were laid on the ground about four feet apart, and two performers stepped out to dance. The Dyaks first laid their weapons—kreeses (swords) and shields—on the ground, and after a good deal of pantomime and jumping about, grasped their arms and went through

a mock performance of real fighting. They became very much excited, and perspired profusely, but through their wildest gestures, when the sword was lifted as if to slay, or the spear poised as if to hurl in earnest, the rhythm and time of the music were always kept. The first pair fought till one was supposed to

HEAD-HUNTING DYAKS IN WAR PAINT.

be killed, and the other prepared to take his head. Only a few weeks before this soldier had really taken a head while serving in an expedition to punish a refractory tribe. Another pair were more romantic. Just as the conqueror was going to cut off the head of his dead enemy, he discovered that he had killed a friend, and went about with every show of mourning, and exhibited every attitude of remorse. Another Dyak performed alone; he took off the walk

and manner of a hornbill in a most comical way, and then the manner of a goat with equal success. The presence of ladies deterred him from going through his personation of a monkey.

During one of the dances a most curious episode occurred. One of the performers was suddenly seized with a hysterical fit. Everybody seemed to know exactly what to do. One man held him up, put his mouth close to that of the patient, and made a noise as if he was kissing the sufferer. Such, however, was not the case; he was speaking in an endearing, coaxing way to the spirit they supposed had seized the performer, to try and persuade that malignant being to go away. Others slapped the hands, breast, and abdomen of the man in the fit, and poured cold water on his head. In about five minutes he recovered, but his friends took him away, and would not let him continue the performance. The belief that nervous seizures are due to an evil spirit suddenly taking possession of the patient is universal among savages. Even peaceable sleep is looked on by the Malays as a wandering of the sleeper's spirit out of himself. A Malay never awakens another man suddenly; he touches him gently, and speaks in an endearing manner to the spirit, asking it to return, and will go on coaxing for half an hour rather than speak roughly or suddenly. We have frequently seen this performance going on.

It is a curious thing that Malays and Dyaks do not know what kissing is, and have no such word in their language. The nearest approach is "chium,"

or smelling; for this is their form of endearment. The cheek is smelt with an audible sniffle and an upward movement of the nose, but this is mostly with children, as adults do not care much to *chium.* Some have thought that this may be because the mouth is usually dirty from chewing tobacco, and native women who do not chew or smoke have been seen to kiss a child with the mouth; but still the native word is to smell, not to kiss. New Zealanders rub noses for the same purpose; and even such a civilised race as the Japanese do not understand what it is to kiss. Among the latter race, the lips of grown-up women are so heavily painted that kissing would be unpleasant. I have not been able to find out much as to the habits of other savages in such matters, but it is well known that even in England, infants—who of course are more like savages and animals than adults—do not kiss much before they are nine months old. Till then they only sniff or rub, and generally learn to kiss from their mothers.

Such being the habits of men, it would be interesting to know the ways of the orang-outang, and other man-like apes in such matters. Mr. Davies, the resident at Kudat in N. Borneo, tells me that having kept a male and female orang for about three years, he has seen the male kiss the female many times with his nose. He could not, however, be certain whether this was a sign of affection, or whether it was only done to find out what she had been eating. He was in the habit of taking her food away from her if he could, even out of her mouth.

Mr. Little of Mempakol, also on the west coast of Borneo, says that the orang presses his projecting lips into the female's mouth, generally when she is eating, and that this is either to take the food out of her mouth, or to taste what she is eating.

On the other hand, Mr. Bartlett, of the Zoological Gardens in London, once introduced a young female African chimpanzee to a young male. They clasped each other, uttered loud cries, and pouted out their lips till they touched. This was looked upon as kissing by several witnesses.

Thus there seems to be some doubt as to the habits of man-like apes; but still it is evident that some interesting questions are involved in this investigation. Smelling and rubbing are animal habits, but if it can be proved that such are the customs of apes and the lower races of man, while kissing is confined to a higher civilisation, the development of kissing might furnish a new chapter in the history of evolution.

CHAPTER XVIII

IN THE JUNGLE: THE ORANG-OUTANG

THE most interesting exports from Borneo are the three great Chinese delicacies—edible birds' nests, *trepang* or sea slug, and sharks' fins.

An Englishman's idea of birds' nests is that of a mixture of mud and moss and feathers, which even a Chinaman would not eat; but an edible nest is something very different. There are three qualities that vary considerably both in size and appearance—the white, the red, and the black.

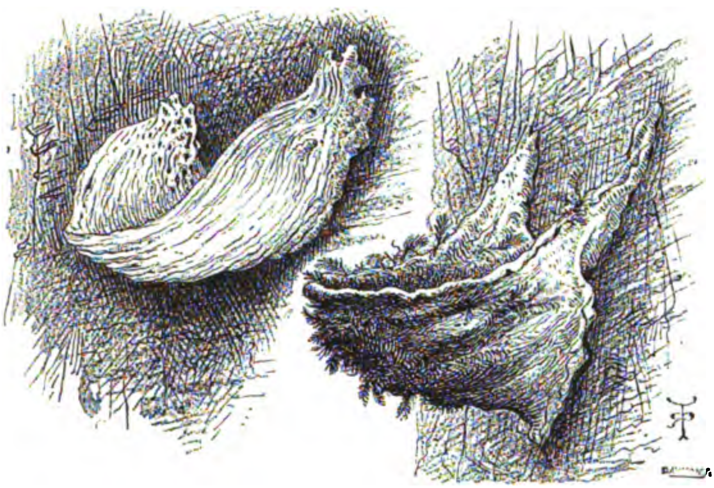
The nature of these nests will be best gathered by looking at the illustration, where Mr. R. Pritchett has drawn a white and a black nest natural size.

It will be seen that both have been attached to the sides of a cave, where they formed a sort of bracket to hold eggs rather than a complete nest such as would have been built in a tree.

A very perfect example of a white specimen is delineated in the upper part of the drawing. The nest is composed of a thin wall built up of threads of whitish, semi-transparent, gelatinous matter about the thickness of very thin macaroni. It contains neither

dirt nor feathers, and the substance is the saliva of a peculiar kind of swift—*colocalia nidifica.* This is the finest and most expensive kind, for a pound is worth at least fifty shillings in Sandakan, and no less than £10 in Hong-Kong. A pound contains about seventy nests, three of which are required to make soup for one person.

The black nests (see the lower part of sketch) are



BLACK AND WHITE EDIBLE BIRDS' NESTS.

not only made of dark saliva, but are filled with black dirt and covered with feathers. The edges, too, that adhere to the rocky side of the cave are dark red, and the general appearance is most unattractive, especially when compared with the clean delicate structure of the white nests. These black ones are not worth more than two or three shillings a pound.

Red nests are intermediate between the white and black varieties. The sides are not pure white, and

contain a few feathers, while the edges are tinged with red. The price is also intermediate, being about two-thirds of that for the white quality. The nature of these nests will be again referred to in the next chapter.

Trepang is a great black slug which is found on the reefs. When cured it is about four inches long and nearly two across. The animal is split down one side to clean out the inside, and when dried a dark, firm, thick, gelatinous mass remains.

Sharks' fins describe themselves; they are usually small, and only a portion of the fin is good to eat.

One night we had all these three delicacies for dinner, cooked by a Chinaman. The birds' nests were served with chicken soup; the white filaments of the nests, still bundled together, floated in the broth just like vermicelli. The nest itself was practically tasteless, but its presence gave a richness to the chicken soup which it would not otherwise have had. The trepang was served as a sort of *entrée* with pieces of beef. It had been cut into moderately thin slices transversely across the slug, and the whole stewed together. It tasted excellent, something between a cock's comb and the palate of an ox.

The shark's fin was also stewed, but with pork instead of with beef. This also was soft, with a number of small firmer gelatinous spines running through the mass like needles, and was exceedingly good eating.

In all these one sees a common property—gelatinous or mucous masses, highly charged with

organic phosphorus. For this reason they have the same effect on certain temperaments which oysters and truffles have on some men; and it is to this stimulating power that they owe their popularity among the Chinese.

As edible birds' nests are scarcely found outside Malaysia, and the caves in which they are gathered are usually in inaccessible places rarely visited by Europeans, I was particularly anxious to see the celebrated bird's nest caves at Gomanton, about twenty-five miles from Sandakan. This I was able to do by the kindness of Mr. A. Cooke, treasurer of the British North Borneo Company, who got up a party for the occasion; and as during the journey we also came across that unique and strange inhabitant of Borneo, the great man-like ape or orang-outang, this expedition was one of the most interesting of my tropical rambles.

Our party, consisting of Mr. A. Cooke, Dr. Walker, and the author, left Sandakan in a steam launch at 6 A.M. on 17th April. We steamed for three hours across the bay, and a short way up the Sapu Gaya River, then paddled for three-quarters of an hour up that stream, and finally walked about twelve miles through the jungle to the caves at Gomanton. The entrance to the river was typical of Borneo. On first approaching from the bay you see nothing but mangroves, then a little higher up the river you perceive something that looks like a submerged cocoa-nut palm, but which is really the nipa palm. This is a most valuable tree for the natives, for it grows in the water,

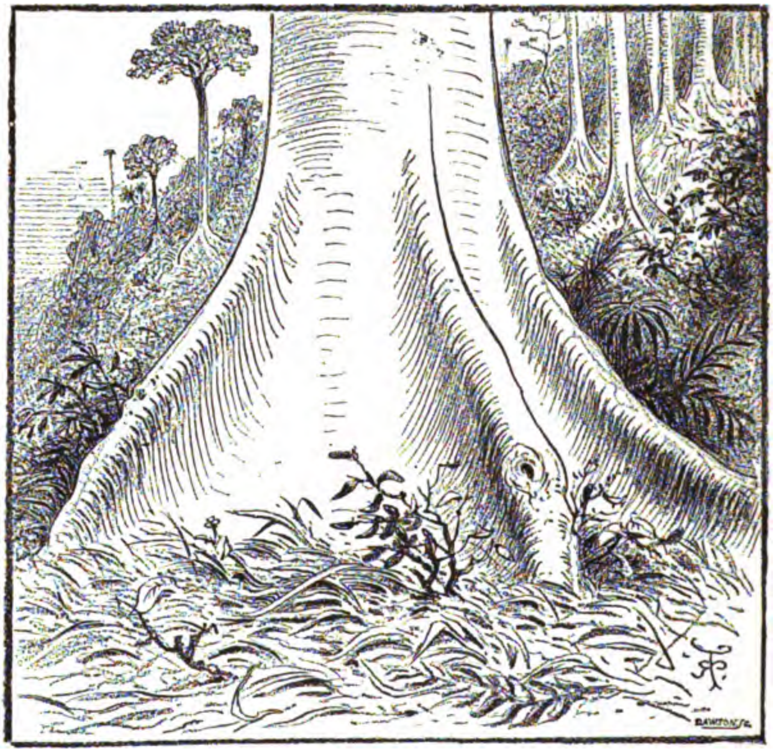
like a palm without any stem, and the fruit is carried on the end of a spike, a few inches only above the surface of the river. The leaves are used for making both the roofs and sides of houses, as they form an excellent natural thatch. Ascending the river still farther, the water gets more brackish and the mangroves disappear, while nipa covers both sides of the stream; still higher up the nipa in turn grows more sparsely, and becomes mixed with other plants, till by the time the water is quite sweet the nipa is entirely replaced by purely jungle shrubs. Above this navigation begins to get bad, for great trees have fallen across the narrow stream. Some of their trunks are low in the water, so that the canoe can be dragged over them, but others are stretched across the river in the air, and one can with difficulty crawl under them.

At last we come to a landing-place, and enter the jungle. A path had once been cut through the bush to Gomanton, and though now much overgrown, was still an improvement on what it would have been had nothing been done. The general aspect of this Bornean forest was most uninteresting, and could not compare in beauty with the jungles in some other parts of the world. We walked the whole twelve miles to the caves over an undulating country in shade, though, except during a short thunderstorm, the sun was shining brightly all the time. The trees were so close together, and their foliage so thick, that full sunlight never penetrated to the ground; and at no time could one see more than a few yards ahead

owing to the dense growth of underwood. Some of the trees were enormous, more than 200 feet high, others much smaller, and the interstices between were filled up by thin straight-growing shrubs, and by a tangle of creepers. To the eye the tree-tops did not look particularly continuous, yet there was uniform shade below; and still more curiously, the great ape—the orang-outang—can traverse miles of forest by simply reaching with his long arms from bough to bough, without ever having to come down to the ground. The development of creepers and parasites was not nearly so great as in Fiji, and in spite of a few flowering plants there was a monotony about the colour of the ground foliage which made the general aspect of the jungle uninteresting. Nowhere do you see the lovely mixture of the bright delicate green of the tree-fern with the darker shades of most forest undergrowth, or the tangle of epiphytic moss and fern which form such a striking and attractive feature in the jungles of Fiji or Brazil. Mr. Burbidge in his interesting book, *The Gardens of the Sun*, says that the beauties of Borneo are to be found aloft, and that on the top of the great mantle of foliage which hides the earth there is another world of vegetable life, where large orchids and other strange plants luxuriate in the heat and light of the sun's rays.

The world of the jungles of Borneo is, in fact, built in two stories. The bright and beautiful upper story is on the tree-tops, where splendid orchids court the sunshine, and numerous brilliant birds flit among the branches. Here the great apes live, feeding

on mangos and durrian, and swinging themselves by their huge arms from tree to tree. The ground floor is a damp and gloomy world, where a ray of sunshine rarely penetrates, but swarming with blood-sucking leeches, and sparsely inhabited by men and



TYPICAL BUTTRESSED TREES, BORNEO.

pigs and deer, by the elephant, the wild ox, and the rhinoceros.

A very striking feature of the big trees here is the great development of buttress roots. The general appearance produced will be best understood by a glance at the engraving. The height from the ground to the

place where the buttresses begin to project beyond the round trunk of the tree is sometimes twelve or sixteen feet, while the buttress itself is often not more than six or eight inches thick. This makes the process of felling one of these big trees a very serious operation, for a platform has sometimes to be erected high enough to allow the workmen to cut the tree above the buttresses. For some reason or other very few of the jungle trees have anything but surface roots, so this growth must have been developed by the necessity for support to a very lofty tree.

But if the appearance of the vegetation was monotonous, there was far more life in this jungle than is sometimes found elsewhere. We saw the spoor and dung of the elephant, and the foot tracks, with their great toe mark, of the rhinoceros, and also several deer and wild boars and small monkeys. We heard the constant cry of the Argus pheasant, and occasionally the peculiar note of the great hornbill; various kinds of crickets, grasshoppers, and lizards filled the air with an incessant chirping, and an insect of the beetle tribe made his loud note heard over all other sounds. There were few mosquitos, but we suffered a little from leeches; for even in this the dry season, the ground and foliage were so wet that the leaves swarmed with them. It is curious how quickly leeches appear to become conscious of the presence of man. If you sit down for a few minutes you will see them coming on all sides, or they will climb up a walking-stick to get at your hand. They stretch themselves out full length, catch hold of something

with their sucker, and then bring their tail up to the mouth, with the body arched upwards; then, with the tail as a support, the sucker is again projected the length of the body, and so progress is effected. Many are not more than an inch long, but they get under your clothes in an extraordinary manner. The bite is not painful, the only danger is that in trying to tear one off, a portion of the sucker is sometimes left in the flesh, by which a very bad sore may be set up. The natives remove them by putting a bit of damp tobacco over the leeches' heads, which then immediately relax their hold.

After traversing the forest for about an hour, I suddenly heard a shot fired by one of my friends who was walking ahead. I looked up and saw a great mass of brown hair climbing hand over hand up a small tree. The coolie just behind me called out "Mias"—the Malay word for orang-outang; then another shot was fired by Mr. Cooke, and the great beast fell to the ground. It was very fortunate that he was low down and climbing the stem of a tree, for had he been among the branches he would either have made a bed of twigs to die on, or else have fallen across some bough that would have kept him from coming to the ground. We ran up and saw a great groaning bundle of reddish-brown hair, the ape's head tucked in between his arms, and his limbs all curled up together in a ball. We approached carefully in case he might make a last spring, but in a few minutes he rolled over dead. He was found to be a fine male, 7 feet 5 inches across the out-

stretched arms, and 4 feet $\frac{3}{4}$ of an inch from head to heel.

He was propped up, and I took a photograph so as to show the sort of jungle which is the home of the orang-outang. Of course there is the same difficulty in giving the expression of a dead orang-outang as there would be in obtaining that of a man under

HOME OF THE ORANG-OUTANG.

similar circumstances, and the whole body had collapsed so much that I could not get the natural pose of the limbs. The jaw of course had fallen. This last we tried to remedy by putting a big stone between his teeth, making a hole in the lips, and then tying them together with a bit of creeper. String is never wanted in a Bornean forest; there are always plenty of creepers to supply its place.

One of the photographs is here reproduced. The expression of the face is pretty good, except the drooping jaw; and one sees at once the characteristic appearance of an orang-outang in the squat, pot-bellied body, and the disproportionate length and size of the arms compared to the legs.

On our way home next day we shot a female orang-outang, but she, as is usually the case with these apes, managed to die on a bough, and did not fall to the ground. Two coolies who lagged behind and went to look for her said that they were chased by the male, but went off in different directions and so escaped him.

Our big ape was of the variety known as Mias Pappan, or Mias Chappan, the largest kind known. This variety is distinguished by two black callosities on either side of the face that look like projecting cheek bones, but which are really thickenings of the skin. He had been eating wild mangos and wild durrian, which are very common here, and they are a very favourite food of the orang-outang. What strikes one most in looking at him are his enormous arms, quite out of proportion to the other limbs both in length and thickness. He uses them most climbing hand over hand, with but little assistance from his legs, and swinging himself by the branches from tree to tree. In this he differs from the other great man-like ape, the gorilla. The latter frequently comes to the ground and moves by a series of crouching jumps, using his hands to balance himself as he leaps. The orang-outang, on the contrary, never comes to the

ground except to drink, but lives and moves among the tree-tops of the dense forest he inhabits. He is a roving animal, and rarely occupies the same nest above a few nights. He goes about with his family, the male, the female, and a young one. The two latter alone occupy the nest, while the father sleeps in a neighbouring branch. These apes have not discovered the art of covering either their nests or themselves. In confinement there is nothing the orang-outang likes so much as a blanket, or even a newspaper to wrap round himself for the sake of warmth.

Mr. L. E. de Crespigny, an employé of the Sarawak Government, has had many opportunities of studying this animal in its native wilds, and from him I gathered a good deal of valuable information about the great orang. The biggest he has met was no less than 4 feet 7 inches high, and 8 feet 10 inches in stretch from finger end to finger end.

Of course the most interesting thing connected with the great apes is their approach to the lowest races of man. The stories which used to be current of a race of tailed men in Borneo has been shown to have arisen from mistaking the tails of the monkey-skin cloaks worn by some inland tribes for real tails; and the discovery of men with tails would point to a connection with monkeys and not with apes, who have no tails. Mr. de Crespigny has, however, sometimes seen a native face unmistakably and ludicrously similar to that of the orang-outang, and very often observed among Muruts and Dyaks an extraordinary length of arm, the stretch being in

these instances longer by several inches than the height of the individual. Curiously enough, when I showed my photograph of a Western Australian man and woman, given in Plate VI, p. 244 of this book, to my friends in Borneo, they all remarked at once how like the expression of the man was to that of the orang-outang. I must, however, say that after seeing both the lowest man and the highest ape in their native condition, the gap between the two is larger than I had anticipated. The difference is difficult to define in words, but according to ordinary ideas, one was undoubtedly a man and the other a monkey.

Mr. de Crespigny had never himself seen a mias whose intelligence had been fostered or developed by man, but was informed that a Murut had formerly owned a mias, who lived with the man's family, followed him to the fields or forest, and helped to bring in firewood to the house. Mr. de Crespigny also heard of a mias who was taught to bring fire to his master when desired to do so. This is all hearsay evidence, and probably not worth much, possibly not more so than the story of Apollonius, who visited a country in his travels where pepper was cultivated by apes.

All over India, Malaysia, and the Melanesian Islands, women carry their children astraddle of one hip instead of in their arms as in Europe. The infants like it, and the burden is more easily borne by the mother than by our method. It is a very curious fact that all apes carry their young the Indian

fashion, so that we have here a very great similarity in their domestic customs between men and apes.

After five hours' tramping through this forest, over slightly undulating ground, and across a few small water-courses that would be impassable in the

EDIBLE BIRD'S NEST CAVE, GOMANTON (EXTERIOR).

wet season, just as it was getting dusk, the guide called our attention to a number of bats flitting among the trees, which he said came from the caves. About twenty minutes later we began to mount some very rough limestone rocks, and at 6.15 P.M. saw quite suddenly in front of us a huge opening 250 feet wide and 100 feet high, on the side of a mountain, which is the Simud Itam, or black entrance, to the

great bird's nest caves of Gomanton. I have reproduced this view in the engraving, where creepers are seen hanging in front of the mouth of the cave, while a tangled mass of foliage fills up the foreground.

CHAPTER XIX

GOMANTON: EDIBLE NEST CAVES AND UPAS POISON

Gomanton, in spite of its Saxon termination, is a purely native name; but I was unable to find out the meaning of the word. The great opening mentioned in the last chapter was at the bottom of a hill so covered with jungle that neither the size nor shape could be distinguished.

The mountain is really only 1200 or 1400 feet high, but has not yet been accurately surveyed. A clear rivulet ran along the base, and a tiny stream of black fetid water trickled out of the cave. The huts of the nest-collectors were built on piles just inside the mouth, so as to be raised above the layer of damp, black bat and swift dung which covers the bottom of the cave. Beyond them rose a magnificent dome or beehive-shaped chamber 400 feet high, with some light coming through holes in the top; but it was now getting so dark that we could see little but hundreds of bats flitting about the mouth of the cave.

All night long there was a perpetual noise of bats flitting about, swifts coming home, and a constant patter of the droppings of these animals on the thatch

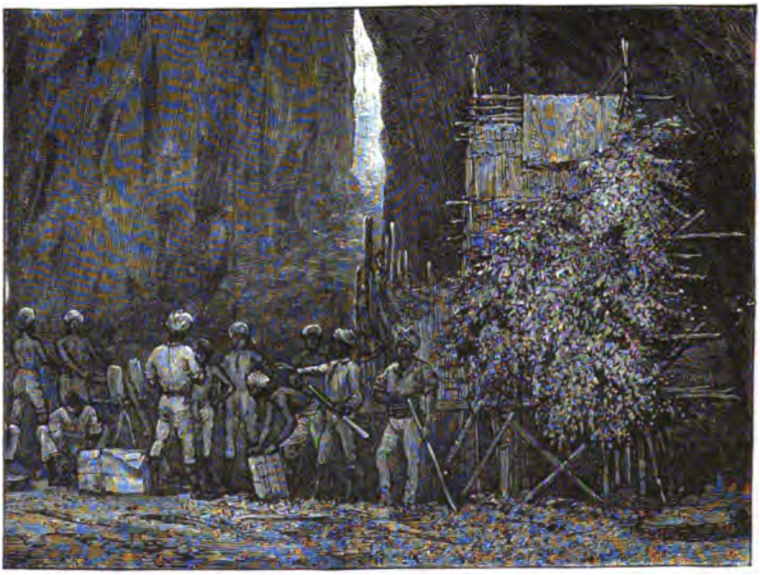
of our little house of leaves. The collectors, in one of whose houses we slept, are a peculiar tribe called Buludupihs; they are said to have a higher cranial capacity than their neighbours, but we could see no sign of any superiority.

About 5 A.M. next morning the bats who had been out all night began to return, and from then till 6.30 A.M. they literally swarmed by thousands into the cave, always coming in at the edges of the mouth. I tried to count how many passed a length of about ten feet in a minute, but the numbers were so great that it was impossible to follow them. About 6 A.M. the swifts began to go out, but not in such numbers or so regularly as the bats, so that the birds and bats inhabit the cave alternately by night and day respectively. The outgoing of the bats in the evening appears to be still more regular. Governor Treacher has described graphically the manner in which the bats go out at dusk, and the swifts return to the cave. Standing on the top of Gomanton Hill, he says that "at 5 P.M. a multitude of bats began to issue from the Simud Itam in quest of their nocturnal food. They came out in a regular ascending spiral coil, turning from left to right in a most regular manner. As the top of the spiral coil reached a certain height in the air, a large body of bats would break off, and after revolving rapidly from left to right in a well-kept ring, and ascending gradually, would suddenly dash off to the sea towards the mangrove swamps and *nipas*. Amongst them were three white bats, very conspicuous, which the men call the rajah, his wife

and child. Eagles and hawks hovered about to secure some for food. They (the bats) commenced coming out at 5 P.M., and were all out by 5.50 P.M. About 6 P.M. the swifts began to return, but not with the same regularity as the bats went out, some returning all night."

At 7 A.M. next morning we started to explore the caves, but before going into details it may be well to describe the broad features of the whole. The hill of Gomanton is literally honeycombed with caves and holes; but leaving out all small caves, openings, and passages, which run parallel or into the main hollows, the mountain encloses two great domes or beehive-shaped chambers, one on the top and to the side of the other. The lower and smaller one, 400 feet high, is entered by the Simud Itam, or black mouth; the upper one, which is no less than 850 feet high, by a much smaller opening called Simud Putih, or white mouth. Imagine a hill whose shape you cannot trace on account of the jungle, or see whether it is isolated or part of a ridge of high ground. At the foot of this is the Simud Itam or black entrance already described. Then climb up the face of the hill 400 feet by zigzags and ladders, and at the edge of a great chasm, which is a breach in the top of the lower dome, see a ledge with a small mouth only 50 feet wide by 30 feet high, which is the Simud Putih or white entrance to the upper and greater dome. The bigger chamber has thus a small insignificant-looking entrance, while the lesser dome has a more imposing approach.

Returning now to our sleeping-place in the Simud Itam, the length of the opening is not more than thirty yards before you are inside the lower dome. This is an irregular beehive-shaped chamber, lit right and left by breaches in the top, beside numerous smaller holes and cracks which pass through the side of the mountain into the open air. There are a few



EDIBLE BIRD'S NEST CAVE, GOMANTON (INTERIOR).

stalactites or icicles of limestone hanging down from the roof, but no stalagmite or accumulation of limestone on the floor of the cave. Many parts of the top and sides are honeycombed like the peculiar ornamentation of some parts of the Alhambra, and these hollows, combined with the vertical lines of the stalactites, give a curious architectural effect to the whole. Long rattan ladders, some 200 feet long, hang down

from the top of the chambers to assist the collectors in reaching the nests; in dark corners masses of bats can be seen hiding from the light, and the floor is thickly covered with their black, damp-smelling guano. The swifts build their nests in the holes and on the sides of this great chamber. The engraving gives a fair representation of the inside of the dome viewed from the entrance. The erection of leaves and mats built on piles is the dwelling-place of the jungle tribe who collect the nests; while behind, light is streaming down through one of the breaches in the side of the chamber.

Then we climbed outside the mountain for 400 feet, up a very steep zigzag path, with the assistance of a few fixed ladders where the rocks were nearly perpendicular.

The whole hill appears at one time to have been a coral reef. Jagged bits of coral are still projecting, but are now coated with a slippery slime of jungle dirt, so that the climb from the lower to the upper cave is very bad going. At last we saw in front of us a great chasm, which is the left-hand breach in the top of the dome of the lower cave before mentioned, and on a ledge, just to the right of this, lay the small mouth-shaped opening, only 50 feet wide by 30 feet high, of the Simud Putih or white entrance. The origin of the name is obvious, for instead of the dark, damp, black-floored cave of the Simud Itam, the Putih is a bright, clean mouth in the white limestone rock, and the few native houses in the entrance are much cleaner and drier than those below.

Standing at the opening, and looking down a low steep descent of about eighty feet in length, which does not seem to lead to anything, you can scarcely realise that this is the entrance to a far larger dome than the one which has already been described. However, at the foot of this descent there is a perpendicular hole going no one knows where, but probably into the lower cave. Then you turn to the left behind the chasm at the entrance, and passing through a passage, in some places 150 feet high, for rather more than 100 yards, enter the great dome 850 feet high. In the roof of this there are seven openings large enough to have names, and some of these are run actually through to the summit of the Gomanton Hill, so that when standing on the top of the mountain there is only a thin crust between your feet and the empty space of the dome. Here, as in the lower cave, the swifts build on the sides and in the holes of the rocks, and there seem to be fewer bats than in the Simud Itam.

As the nests are situated in very awkward positions, and at a great height, much skill and ingenuity is employed in getting them, and only skilled men can collect. The higher the nests are situated the better they are, being drier and freer from dampness; and those from the Simud Putih are more valuable than those collected in the Simud Itam. For taking the nests situated lower down, and for getting those out of arm's reach, a very long bamboo, spiked, and with a candle near the spiked end, is used; with this the collectors can see and detach the nests.

Those situated higher up, and consequently the most valuable, being mostly at dizzy heights (up to 600 feet), are taken by means of rattans, or rattan ladders lowered down between holes and small outlets, which are some of them too small to allow a man to pass through. Where a man can pass through, the natives employ a rattan or ladder long enough to reach down to the nests; otherwise a ladder long enough to reach the ground is let down, so that the collector can ascend. By using sticks and bamboos inserted in crevices and holes, they can in an extraordinary manner work their way along the faces of these precipices to a required point; and sometimes you see stages fixed right on the roof, to which it would seem utterly impossible for a man to work his way. Long bamboos with steps up to them, and secured by rattan stays, with sitting stages, are also employed to work from the ground. The caves can be worked equally well by night as by day without any fear of scaring the birds.

There is still some uncertainty about the best seasons for collecting. Mr. Bampfylde, to whose valuable report on the Gomanton caves we are already much indebted, says that formerly there were only two seasons for collecting, one about March, the other about two months later. Now, however, they say that the most remunerative way of collecting is to divide the year into four seasons. No fixed dates can be given for these seasons, as the gathering depends on the laying of eggs, and the native ideas of intervals of time are very vague. The first three seasons

are supposed to yield white nests, the fourth only black ones. Still, these last must be collected to ensure a good harvest for the coming season. By these means a larger quantity and finer quality of nests are obtained than when two collections only are made annually. It appears that if nests are left too long, the birds go on adding and adding to them, so that the gelatinous mass becomes dirty and of low value. I got very unsatisfactory information as to the origin of the different kinds of nests, the white, the red, and the black. In the lower cave of the Simud Itam they showed us two kinds of eggs, one a good deal smaller than the other, and said they were laid by two kinds of birds. The smaller egg came from the black nests, the larger from the red nests. At the upper cave of the Simud Putih they also showed us some eggs, and said that two kinds of swifts made white nests, and a third species, which laid a small egg, the black nests. One of the eggs they showed us was larger than the egg which was said to come from the red nests in the lower cave. So if we suppose that one of the so-called white nests in the upper cave is really the red variety, it would appear that there are three kinds of swifts which lay big, medium, and small eggs, in white, red, and black nests respectively.

In the Philippines I heard a very different story of the origin of the three colours of nests. Mr. Robellin, a German plant-collector, who had visited the bird's nest caves in the island of Palawan, told me the opinion of the natives there. They say that the nests first built at the commencement of the

breeding season are white if taken before the eggs are laid. The bird next builds a nest stained red with blood, which is again taken; and lastly, a third black nest. As long as white nests are being built, the natives take all kinds. But when later on in the season only red and black can be procured, they cease collecting for the year, both to allow the birds to breed, and because these two qualities of nests are not worth taking by themselves.

We may remark that though this account differs materially from our Bornean reports, it so far corroborates Mr. Bampfylde's information that more white nests are obtained if collections are made four times a year than if only two are attempted. The subject is worth working out from a commercial point of view, for the experience of Sarawak and other nest-producing countries, is all to the effect that caves increase in value under European management.

The origin of the material from which the edible bird's nest is constructed is also very obscure. We have already mentioned that the white nests are composed of pure threads of gelatinous-looking matter. It used to be asserted that the swifts simply built their nests of a soft fungoid growth that incrusts the limestone in all damp situations. This grows about an inch thick, dark brown on the outside, white on the inside; and it was supposed that the best quality of white nests were formed from the latter portion. This theory seems to be disproved by the fact that chemical analysis shows that the nest contains no vegetable matter, but consists entirely of pure animal mucus.

It is said now that the swifts have very largely-developed glands in the throat from which white mucus is secreted in sufficient quantity to make a nest; and that on a much smaller scale the common European swallow cements the clay of its nest with a mucous incrustation.

The question will never be settled till some competent naturalist is prepared to spend a month or six weeks in the caves, and to see with his own eyes the male and female of every bird that lays the three sizes of eggs in different coloured nests. Gomanton would be much better situated for such a research than the island of Palawan, or even Sumatra, where similar nests are collected. Communications with Sandakan are so easy that there would be no difficulty in getting suitable provisions, only the naturalist should take up his residence in the clean, dry Simud Putih, and not sleep, as we did, in the lower damp-smelling cave of the Simud Itam.

The Gomanton caves are a source of considerable revenue to the North Borneo Company, for the native chief who gathers the nests pays a substantial sum for the privilege of doing so, and a company is now being formed in England to work the deposits of mixed bat and bird guano which lie on the bottom of the caves. It is asserted that the guano is fifty feet deep in places, and the proposal is to run a light line of narrow gauge railway from the Sapu Gaya River to the caves, and then ship the produce, after drying, direct to England.

My friend Mr. A. Cooke made me a present of one

of the most interesting specialities of Borneo, a *sumpitan* or blowpipe with a quiver of poisoned darts. This is one of the strange weapons which are characteristic of Malaysia in the old world, for the area to which its use is confined appears to reach from the south end of the Malay Peninsula to Sumatra, Borneo, Sooloo, and in a very degraded form to the Philippines. Blowpipes with poisoned darts are, however, also used in Guatemala, and in parts of South America. In Borneo the *sumpitan* is a fine blowpipe about eight feet long, with a spear head lashed on to the far end. The hole is about one-third of an inch across, and bored nearly as true as a gun barrel by a very primitive water power. The darts are about ten inches long, and made of light wood, pointed at one end to receive the poison, and tipped at the other with pith so as to fit the bore sufficiently, but not too tightly.

It seems a most unhandy weapon to use. In Sooloo I got a native to shoot some darts at a tree about twenty yards off. He grasped the tube with one hand near his mouth, the other fourteen inches up the barrel, so that there were at least six feet of the blowpipe unsupported. He then inserted a dart, and with a great deal of effort blew it out of the tube. Sometimes the dart stuck in the tube, or would hardly start, as it fitted too tight; but he managed to hit the tree pretty often. In the open it seems a very inferior weapon to the bow and arrow, being much more difficult to use, much shorter in range, and much more inconvenient to carry. At the same time, a bow and arrow is useless in a thicket; and it is quite possible

that a jungle man lying in ambush with his *sumpitan* resting on a convenient branch, may find a blowpipe the more serviceable weapon in dense tropical undergrowth. The darts are covered for about one and a half inch from the point with what looks like hard brown liquorice. This is the celebrated upas poison. When fresh and properly prepared, a wound from a poisoned dart will turn green, the victim become much convulsed, the jaws rigid, and death will ensue in about two hours. Mr. de Crespigny, whom we have mentioned before, finds that in the Sarawak country two vegetable juices are used to prepare the poison—the *upas*, and that of a shrub called *bima*. There appear to be many varieties of the upas tree in Borneo. The bark of these trees is deeply furrowed, and when incised a small quantity of liquid exudes. This does not appear to be the sap of the tree, but an exudation from the bark itself. The freshly-drawn juice concretes in an hour or two, and is then rather brittle. Both in appearance and consistency it resembles Spanish liquorice, except that it is not quite so dark. The taste is intensely bitter, as if it was concentrated quinine.

Upas is the true poison, but it is of little use unless intensified by an admixture of bima. This is an extract procured by maceration from the roots of several low shrubs. The root, after being macerated to a pulp, is dried in the sun, when it assumes the consistency of dried upas juice, but is of a raw sienna colour. Like the other, the taste of bima is intensely bitter; and the juice is not in itself at all

poisonous, but without it the upas would be comparatively harmless.

When the poison is required for use, each kind is rubbed down separately with warm water, and mixed in the proportion of about two parts of upas to one of bima, with much muttering of spells. Some men have a reputation for their upas, either because they mix the poison with greater skill than others, or obtain it from some more deadly tree, or collect it at a certain stage of growth, or at a particular season of the year. The Dyaks say that some have more powerful incantations than others. One thing, however, is certain, that however potent the poison may be when first mixed, it loses strength after a month or six weeks; and that the power of the poison cannot be renewed by the application of lime juice, as has been sometimes erroneously asserted.

Everybody remembers the original story of the deadly upas tree which grew in Java. No beast could approach it, birds which flew over it dropped down dead, no vegetation flourished near its unhealthy presence, and the wood was only procured by convicts who were promised their liberty if they survived the danger of felling the tree. This is a curious mixture of real facts and accidental circumstance. The original tree from which this story was derived still exists in the island of Java, near Jokko. The tree is really dangerous to fell, for if a chip hits the skin it is asserted that a violent but not dangerous eruption is sometimes produced. But this particular one stands near a place where carbonic acid issues from the vol-

canic soil, after the manner of the well-known Grotto del Cane near Naples, so that really any animal which approaches is liable to be killed by the poisonous gas, not by any emanation from the upas. As the effect of gas only extends a foot or two above the ground, that portion of the story which asserts that birds flying over the tree fall down dead is probably an exaggeration; but still we see that there are some real grounds for the romance of the deadly shade of the proverbial upas tree.

CHAPTER XX

TO MANILLA: HEALTH IN THE TROPICS

I LEFT Sandakan on the 22d of April in the small S.S. *Banca* for the island of Sooloo, whence I expected to catch a steamer to Manilla. By this means I hoped to visit all the observatories—Manilla, Hong-Kong, and perhaps Tokio—which lie in the track of the typhoons in China seas, for these hurricanes usually commence to the east of the Philippines, cross those islands, and then pass either to the south of Hong-Kong, or else follow up the China coast and recurve towards Japan.

Next morning, at 10.30 A.M., a sudden sharp squall struck the ship coming out of black clouds, but without any rain. The wind was south by west, but some fleecy clouds overhead drove from east-south-east. By noon the wind fell, we heard thunder to the south of us, and by 12.30 P.M. heavy rain came on which lasted for an hour and a half. Then the sky cleared, through soft flat clouds with very little cumulus, and the rest of the day was fine. This was interesting, as showing, even in these latitudes, about

6° north, the truth of the well-known rhyme relating to squalls:

"When the wind comes before the rain,
You may hoist your top-sails up again."

I had a curious illustration on board the *Banca* of the difficulty of getting accurate information about climate or weather. We were told that it hardly ever rained in Sooloo, but that vegetation was preserved by heavy dews. However, we arrived during the end of a heavy shower, and every day there was a thunder-storm in the middle of the day, more or less distant from ourselves. As a matter of fact, Sooloo is much less rainy than Borneo, though there is no rain gauge on the island to give accurate data. Most of the rain falls by day, and not by night as in the latter territory.

Late in the afternoon we came to the Spanish town of Jolo, which we call Sooloo, but the natives name it Tiangi (markėt-place). It is a small square town, surrounded by a fortified wall, full of Spanish soldiers and officials, with a very few Chinese merchants. Herr Funcke, the manager of the German Borneo Company, very kindly asked me to stay with him till the Manilla steamer arrived in five days' time.

The plantation on which we stayed was a clearing in the secondary jungle which covers Sooloo. The scenery of this island is very different from that of Borneo. The volcanic origin of the ground stamps its presence in the sharp points of the hills, and in the grass-topped mountain which marks the position

of the highest crater. A dense population in a limited area have cleared the whole of the primary jungle, and though a secondary growth has sprung up in many places, there are numerous openings quite different from the uniform forest of Borneo. The sky was rather less cloudy than at Sandakan, while the land and sea breezes, and daily variation of cloud and weather, were different from those on the neighbouring coast.

Herr Funcke was growing tobacco on the system carried out at the celebrated plantations of Deli, in Sumatra. The object is to produce large, fine, thin leaves, free from holes or blemishes, which are worth five times the ordinary price of tobacco, as they are used for the outside wrappers of cigars.

The most minute care is necessary in every stage of growth, and probably no one but a Chinaman could do the work properly. After the jungle is cut and burnt, square fields of one and a quarter acre each are allotted to each coolie. After hoeing he has to plant out so many young plants, which he has already started from seed in a nursery. Twice a day these tender shoots have to be picked clear of worms, both in the nursery and after each one has been separately planted out in its own hole. From planting out to maturity, ninety to one hundred days elapse according to the soil and climate. When about half grown, flower, stalk, and all, except the ten to twenty lower leaves,—the number depends on the strength of the soil,—are cut off, so that the whole energy of the plant, under the forcing influence of a tropical climate,

is concentrated on a limited number of choice leaves.

During these one hundred days, the amount, and still more the quality, of the rainfall is of vital importance to the due development of the plant. Rain ought to fall every day while planting out, but never while the final cutting is in progress. During the growing time no definite quantity of rain is required, but it must fall at suitable times and in a proper manner. A heavy downpour of rain which leaves an inch or two of water on the ground even for a couple of hours, will destroy a whole crop. Rain which falls with strong wind doubling back the leaves and allowing the drops to fall on the under-surface of the leaf, will cause a blemish that depreciates the value of the wrapper by 50 per cent. So also rain that falls in a few big drops, followed by bright sun which burns the leaves, will greatly deteriorate the quality of the crop. For this reason the night or late afternoon rain of Borneo is very valuable, but still the climate of Sooloo is eminently suitable for tobacco growing.

Sooloo, like Borneo, has two rainy seasons—the small rains about the end of April or beginning of May, and the big rains after the north-east monsoon sets in about October. So by planting out during the small rains, the end of the one hundred days will be in the dry time of year; and the day rain usually clears off so gradually that the sun does not burn the wet leaves. When the crop is ready, the plant is cut down and hung up to dry a little; then the leaves are stripped off the stalk and loosely piled to ferment.

During this process a certain amount of heat is given off, and till this disappears the leaves are not ready for the final processes of sorting and baling before shipment to Europe.

A tobacco plantation is a curious mixture of careful cultivation with rough surroundings. The small, regularly-planted fields are dotted here and there with the burnt stumps of some huge forest tree, and the whole clearing is surrounded by jungle. Here and there we see the long sheds where the leaves are hung to dry, and we are conscious at every step of the steamy, forcing, equatorial climate which is necessary to develop the leaves. In spite of all this the crop is so exhausting that the ground will not produce more than once, so that every year new jungle has to be cleared, and the old left to go back to waste. I remember one night when we went to walk through the plantation about sunset, the whole ground seemed to be breathing out a steamy vapour, smelling of earth and vegetation, like a greenhouse.

On a neighbouring plantation another German was planting cocoa and ylang-ylang, a sweet-smelling, white-flowering tree. The latter is the source of the scent of that name, which fetches an immense price in Paris, as a base for other perfumes.

The climate of Sooloo is decidedly unhealthy. In the town of Tiangi the Spaniards and native troops die like sheep, so much so that Jolo (Sooloo) has been called the "Spaniard's Grave." When the place was first settled they lost 1000 men in four months out of a garrison of 3000, mostly Indios or native soldiers.

The mortality seems to have been due partly to intermittent fever, and partly to a more deadly fever known there as "perniciosa." I could not get any exact detail of the symptoms, but it appears to be a malignant sort of typhoid.

There were four Europeans in the house we stayed in. One was suffering from remittent fever for the first two days of our visit; the last two days another member of the family was down with intermittent fever of a mild type, and the day we left the Chinese cook was attacked with the same disease.

At the same time the number of fever cases in hospital was only 3 out of about 120 Chinese coolies. The next estate is decidedly healthier, and in both fever is of a mild type, and not deadly as in the neighbouring town.

There is also in Sooloo much less of that obscure disease called beri-beri, which is so fatal to the Chinese coolies in Borneo. This strange ailment appears in two types: one has the symptoms of malarial poisoning in dropsy and disturbance of the liver; the other the indications of extreme debility in paralysis of the legs and general breaking up of health. The end is generally the painful death of degeneration of the heart; and no medical skill appears to have any effect on the fatal course of the disease. Europeans are never attacked, only the Chinese coolies; and we must probably look to the low habits and poor living of the latter for the source of the malady.

The inhabitants of Sooloo are decidedly of the Malay type of countenance; but their dress—trousers

fitting tight below the knee, and a sort of jacket,—their horses, and their cultivation, point to a certain superiority over the wilder tribes of the neighbouring islands. Their boats are peculiar in having an outrigger or either side instead of only one, as in the catamarans of Ceylon and the canoes of Fiji. Till recently the Sooloos had a bad reputation for plundering ships. It is asserted that they learned both piracy and the Mahomedan religion from the Malays. It seems strange to find the same creed among races so different in character, and with such different surroundings and habits of life, as the Malays and Arabs. Sooloo and the adjacent island of Mindanao form the extreme eastern limit of Islam, but there appears to be really little in common except the name between the actual religion of Arabia and that of Malaysia. In the former the mosque, the priest, and the dervish, are prominent features of everyday life; and so are the calls of the muezzin to prayer at sunrise and sunset, and the actual devotions of the faithful. In Malaysia there is little of this. The gorgeous mosque is either altogether absent, or replaced by a simple hut; there are no minarets, and I never saw any prayers at the rising or setting of the sun. In these equatorial islands Mahomedanism has never spread beyond the fringe of inhabitants on the sea-shore who are within the sphere of intercourse with the seafaring Malays, and that religion has not entered into the spirit and character of the people as in Northern Africa and in Central Asia.

The Spaniards are very bad colonists, and have

not the art of getting on with natives which Englishmen possess to so great a degree. Though it is five years since Spain annexed Sooloo, no Spaniard is safe outside the walls of Tiangi; but a German or an Englishman can walk or ride all over the country in perfect safety. The contrast in coming from the territory of the British North Borneo Company is very great. In every Spanish settlement along the south of the Philippines, the towns are always fortified and strongly garrisoned, with a gunboat lying in the anchorage; in none of them can the soldiers go beyond the reach of their own cannon, and nowhere is there a pier where even a small steamer can lie alongside. In Borneo it is quite different. There is only one fortification in the Company's territory at Sandakan, where its presence is not required; at all the other stations the residents and other officials live in detached bungalows, and a European can go in perfect safety all through the forests of the interior. The centre of every settlement is the steamboat pier; and a bazaar of Chinese traders soon starts up on the formation of each new place; soldiers and priests, who form the greater portion of every Spanish town, are conspicuous by their absence. The Spaniards even classify the natives by their creed. In the Philippines, Christian natives are called collectively "Indios," Mahomedans "Moros" or Moors, and pagans "Infideles."

We left Sooloo on the 28th April for a tedious voyage of fifteen days to Manilla. The steamer visited the islands of Tawee-tawee and Seeassee in the Sooloo Archipelago, and then called at all the small settle-

ments in the south and east of the big Philippine island of Mindanao, such as Cottabato, Glan, Davao, and Samboangan, before finally turning north to Ylo-Ylo and Manilla. Our course will readily be seen by glancing at the map (p. 308), but the mere detail of saying how we left one port and got into another in so many hours, would be so uninteresting that we prefer merely to give an outline of the general character of this part of the Philippines. All these islands and places bear a greater resemblance to Sooloo than Borneo, for in all these were patches of cultivation and open spaces with grass-topped hills, so different from the uniform forests of Sandakan. The weather was beautifully fine the whole time, with detached cumulus, more or less of the trade type, according as we were more or less in the open sea or near land. The wind was always light and variable in direction, owing to the influence of land and sea breezes, but the higher clouds came invariably from about north-east. Our weather, therefore, represented that of the season when the north-east monsoon was falling very light, before the commencement of the south-west monsoon. Temperature was high and uniform, ranging from about 78° to 90° on deck, while the total amount of uncondensed vapour in the atmosphere as shown by the spectroscope was very large, though the air itself at sea level was not particularly damp.

We had now been nearly a couple of months in Malaysia, and two meteorological phenomena had been very prominent in every part of that region—the almost daily appearance of crepuscular and anti-crepus-

cular rays at sunrise and sunset, and the nightly development of sheet lightning. The first is, of course, the natural result of detached masses of cumulus at a low level sending their long shadows across the sky when the sun is low, and there is not much cloud of any kind at a higher level; but the frequency and beauty of the phenomenon strike an Englishman who rarely sees these rays in his own country.

The rays are merely local, and have no influence on the general economy of the earth, but it is very probable that the constant discharge of electricity may have an influence far beyond the limits of its appearance. I am perfectly certain that a great deal of the lightning is the noiseless discharge of electricity from small masses of cloud, and not merely the reflection of distant thunderstorms. One often sees a small group of clouds glow apparently from internal light at a comparatively short distance from the spectator, who would certainly hear the thunder if there was any; whereas if the glow was the reflection of a distant storm, the clouds would be illuminated from below or from one side. Besides, the number of thunderstorms which we actually experienced was disproportionately small compared to the constant appearance of sheet lightning, especially between sunset and midnight. Sleeping as one did on deck, one could observe that there was always a marked diminution in the amount of electrical disturbance towards the early hours in the morning. There is no reason to suppose that the discharge of electricity is confined to night time; it is only the darkness which enables us to see the

lightning; if we had an organ which saw the amount of electricity collected at different portions of the earth's surface, we should doubtless be conscious of electrical discharge at all hours of the day. Nor is this nightly discharge of electricity confined to Malaysia. Whenever you get near the doldrums the same phenomenon presents itself, whereas outside of this region sheet lightning is only occasionally seen. We have therefore to picture to ourselves that all round the neighbourhood of the Equator there is a day and night discharge of electricity perpetually going on. I do not think that this has been duly noticed by physicists; but there can hardly be a doubt that the constant electric current which is thus set up must modify in some important manner both the electrical and magnetic conditions of the whole world.

No picture of an equatorial climate would be complete without some reference to the general character of the vegetation. The leading feature throughout is the absence of deciduous trees, or of those that shed their leaves annually. Everything is perpetually green in the Tropics,—you never see a leafless tree unless it is dead,—and the uniform winterless climate impresses a peculiar character on the plants and shrubs. India and China have a cold season, and the wood of the fruit trees has time to mature.

But in the greenhouse climate of the Equator nature gives a plant no rest; it is always in a forcing house; and plants which are accustomed to a cold winter run all to leaf and rarely mature their seed—*e.g.* the potato goes all to haulm, and has few or no

tubers, while the turnip grows nothing but leaf with an insignificant bulbous root. Many domestic animals suffer from this climate as much as plants. Dogs get low and out of condition, and cannot breed properly, while sheep grow weedy, and can rarely live on the rank grass of the Tropics. The pig, however, thrives, but then he is a native of India, and such a coarse feeder that he can live anywhere.

At a little town called Cottabato, in Mindanao, on the way up to Manilla in the steamer, we paid the toll which nature demands of every one who enters a tropical jungle, in the shape of a sharp attack of remittent fever. Our knowledge of malarial fevers, whether intermittent or remittent, is still very limited, and many points connected with these diseases are still very obscure. Climate pure and simple probably plays only a secondary part in the propagation and development of some specific infection. Roughly speaking, the most malignant forms of intermittent fevers are found near the Equator, and broadly, the virulence diminishes till we come to the northern limit of the existence of this form of illness.

The most deadly type of intermittent fever is found on the Gold Coast of Africa, and about the mouths of the Niger, Congo, and Zambesi rivers. In all these places the hot stage of the fever is sometimes so intense that blood suffuses on the brain, and causes almost immediate death. At Lagos on one occasion the Colonial Secretary buried twenty-seven out of eighty whites in the short space of seven weeks, and only escaped himself at the cost of a shattered constitution.

It always seems strange that the two or three hours the dangerous hot stage of fever lasts can work so much permanent harm to the liver, spleen, or intestines. In the cold ague stage, when the limbs shake, the teeth chatter, and the livid colour of the sufferer may frighten a novice, there is no danger; but when the cold sweat ceases, and the temperature of the body rises seven to eight degrees in an hour or two, with intense dry heat and distress in the head, then there may be serious consequences; while as soon as the sweating stage is entered, all risk is over for the time.

Next to the region just mentioned we find Delagoa Bay, New Guinea, Panama, the low-lying regions of Mexico, Equador, and Venezuela, and the deadly Terai of India, breeding fever of a slightly less malignant character.

Still less fatal are the fevers found in Algeria, Egypt, and most parts of India or portions of the Cape Colony; in Mauritius, Java, and the Dutch Spice Islands; in parts of Borneo, Hong-Kong and China; in the Southern States of the American Union; in Chili and Uruguay; in Italy, Greece, Asia Minor, and the Caucasus. So mild as rarely to be fatal are the fevers of Holland and Japan, parts of the Philippines and Australia; while in England, Scandinavia, and Northern Russia; in Siberia and Canada to the north; in Cape Town, Fiji, New Zealand, and Patagonia to the south of the Equator, intermittent fever is scarcely known.

Climate has certainly some influence on the supposed

fever germ, for the slightest touch of frost will kill the most severe epidemic of yellow fever; and though marshy ground is certainly conducive to the development of fever, the presence of moisture is by no means necessary. The arid Kalahiri desert is nearly as fatal as the mangrove swamps of Delagoa Bay, and the rotten granite rocks of Hong-Kong are as deadly as the marshes of Italy.

One of the strangest features of malarial fever is that when a man who has escaped an attack in a deadly district moves to a healthy country, he often has a fatal seizure. When a jungle man from the deadly Terai is transported to the plains of India, he usually dies of fever, and many an Englishman has been laid down in London with the fever he brought home from Africa or India.

In any case the effect of fever is greatly influenced by the constitution of the patient and the virulence of the infection. Fever may range from a fatal illness of a few hours' duration to the attack which wrecks a man's constitution for life, or the seizure which is less trying than an ordinary cold in England. But in any case there is always a certain amount of weakness left behind. Shake hands with a man who has just had an attack of fever, and you feel through the flesh to the bone; all strength and elasticity has been lost, the eye is dull, and the features lifeless. Sometimes recovery will take place in a few days, more often in weeks, occasionally never. The strongest constitution is shaken by repeated attacks of fever, though you often find men who think no more of being down for

a day or two with fever than of staying in the house for a cold.

But more insidious in its effect on the constitution of a European, if not so deadly, is the debilitating effect of mere residence in a tropical climate. The moment an Englishman enters the steamy air of the Tropics he begins to lose his superfluous energy, and sooner or later, according to his constitution and habits of life, his nervous and physical strength is impaired. The ambition to do a great deal gradually dwindles away till it is an effort to do his daily work; and the system of doing nothing for himself that he can get a native to do, which he at first resents, gradually becomes a necessity. Then, as the health goes down, the appetite diminishes till it is sometimes difficult to take enough nourishment; and, as in really hot weather, only a restless, wakeful, tossing sleep is possible, the proper amount of repose can rarely be obtained. We have already described the effect of a greenhouse climate on plants and animals; and the constant forcing of damp heat is equally injurious to man. A practical illustration of the effect of heat on stimulating the vegetable functions of life is seen in the fact that a man who shaves once a day in England is often obliged by the more rapid growth of hair to perform that operation twice during twenty-four hours in the Tropics.

It might be supposed that Frenchmen and Spaniards who come from a hotter climate than Great Britain would stand the Tropics better than Englishmen; but such is not the case in practice. The English stand

climate better than any other European race; and this is undoubtedly due to their more healthy habits. The Spaniards in Manilla, and Frenchmen in Saigon, never take any exercise, but lounge about and smoke all day when not on duty. The Englishman, on the contrary, usually rides in the early morning, plays lawn-tennis after business hours, and now that moderation in drink and a certain prudence in diet is the rule and not the exception, and that rapid transport enables critical cases to be sent at once to a bracing air, our countrymen distance all other nations in their endurance of a trying climate.

Still, in spite of all this, when you see a collection of men in the Tropics you note at once that a larger percentage of them are below par than would be so among a similar number at home; and it is certain that a great deal of the failure to open up such countries as Africa, is due to the climatic demoralisation of the agents employed, rather than to the intrinsic difficulties of the enterprise. The best protector of the African savage from European aggressors is the deadly climate of that dark continent.

When trying to discover the origin of this peculiar debilitating effect of tropical climate, one must certainly lay the blame on the steamy nature of the heat. We have already fully described the character of equatorial heat, and the contrast presented by it to the dry heat of Canada or Australia. In both these latter countries the thermometer often ranges in summer from 90° to 105°, but then the relative humidity or measure of approach to saturation will

not exceed 30 per cent of the total amount of vapour which the air could hold. Near the Equator, on the contrary, the temperature is rarely below 78° or over 90°, but the amount of vapour will be within 85 per cent of absolute saturation. Herein lies the difference. Men can work in the two countries just named in the greatest heat without losing their energy, and maintain as good health throughout their lives as at home. The infallible test of vitality is breeding power. Children, born in the Tropics, are rarely strong, while if they are reared there, they either die young or grow up with such constitutions that their lives are a burden to themselves and their friends. In Australia and Canada, on the contrary, Englishmen are almost more prolific than in their own country, and this seems to prove that it is damp and not heat that is so prejudicial to their health.

When you set sail from England, and pass out of the storms and chilly mists of the North Atlantic into the genial, balmy air of the trades, where the wind just raises a dancing curl on the sea, and a few small rocky clouds float across the sky, and at last reach a beautiful green country where strange and graceful forms of fruits and foliage flourish with an unknown luxuriance, it is difficult to believe that a land so fair can be so deadly, and that you have come to a climate which will sooner or later destroy all energy, and even if it does not kill, may return you a wreck to your native shores.

CHAPTER XXI

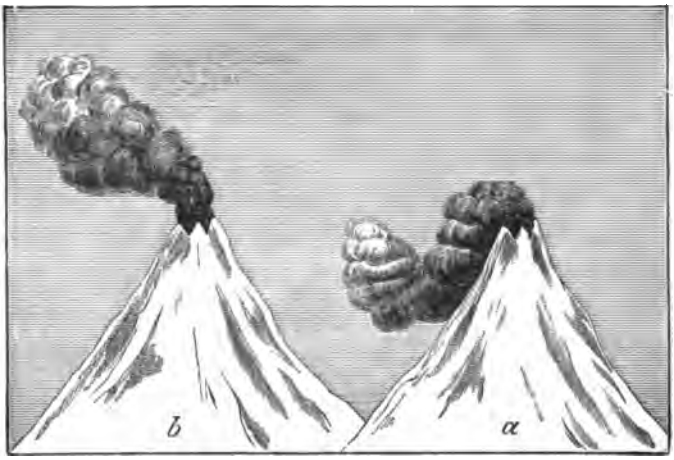
IN THE CHINA SEAS: TYPHOONS

AT Manilla we went to see the Meteorological Observatory which has been for many years under the care of the Jesuit father Faura. He has given great attention to the subject of typhoons, and established a very complete system of observatories in different parts of the Philippines for the purpose of tracing the path of these cyclones, and telegraphing information to Hong-Kong and other portions of China.

At the time of our visit the instruments were being shifted from the establishment in the Atenio Municipal of the old city of Manilla to a far superior building and site in the new *Ecole Normale.* The principal instruments were a very complex meteograph from Rome, which recorded by electrical contacts the height of the barometer, wet and dry bulb thermometers, direction and force of the wind at every hour for ten days on a very small scale. Also some delicate apparatus for the registration of earthquake movements, and the usual apparatus for finding and sending out correct time at noon.

We had much talk on the subject of typhoons,

which undoubtedly differ in nothing but intensity from the cyclones which constantly visit England; in fact Mr. Harries, of the Meteorological Office in London, has traced a typhoon from its birth near the Philippines across to China, till recurving past Japan it traversed the North Pacific and American Union, passed over the North Atlantic and Great Britain, and ultimately died out on the Russian Steppes. Father



VOLCANO OF ABAYON BEFORE AND AFTER TYPHOON.
a, Before typhoon; *b*, After typhoon, and usually.

Faura told us one very curious thing about the influence of an approaching typhoon on the volcano of Abayon, or Albay, near the south end of the island of Luzon. In ordinary weather the smoke of this semi-active volcano rises upwards and blows away before the prevailing monsoon, as in the left-hand figure *b* of picture, while two or three days before the arrival of a typhoon, the smoke of the mountain descends as if it was blown downwards, like *a* in the right-hand figure

of the illustration. Nothing can be seen during the typhoon itself, for dense cloud covers everything, but when the sky begins to break, the smoke is ascending again. He also told us that here, as in other places, the central clear spot in a typhoon is not always over the place where the barometer is lowest, but sometimes a little to one side or the other; and that with the same amount of wind the amount of damage done to houses varied very much. It seems as if the wind has sometimes a more upward direction than at others, and would then be more likely to unroof a house than if the current of air was quite horizontal.

A week was spent in Manilla under the hospitable roof of the English Club, where clean food was very welcome after the garlicky dishes of a Spanish steamer. The town is situated at the top of a large bay where a river runs into the sea. The ground all round is flat, but distant mountains—none very high—are seen on the horizon. This was the hot dry season in Manilla, after the north-east monsoon has almost died away, but before the wet south-west monsoon has commenced; and the character of the weather was singularly uniform.

At sunrise the sky was usually quite blue, the wind light, and the air comparatively cool. Soon after, the blue became white, then a very thin film of cirro-stratus formed over the sky, and gradually increased in density till it gathered into small cumulus not far above the horizon. As the day went on the sky gradually developed into the ordinary tropical type of detached cumulus below, and cirrus or cirro-cumulus

above. After 10 A.M. the sun began to bake tremendously, and the glare from the white roads was very great, but the general atmosphere was bright and pleasant, while the horizon was clear, and the mountains looked sharp and blue in the distance. About 2 P.M. black clouds began to form in the west or north-west, and distant thunder was sometimes heard. Towards 4 P.M. the breeze freshened a little, and as the sun got low the clouds began to fall, and losing their rocky, lumpy form, grew into flattish stratus, while the lofty, hairy cirrus changed more into a thin layer of cirro-stratus. By 9 P.M. the air had become a little cooler, and the sky was almost blue, in which condition the weather rested till the sun began his daily course again on the morrow.

The thermometer out of doors usually ranged from about 78° to 95°, but inside a cool bedroom temperature might be kept about 80° to 89° F. Telegrams of the same date showed that Hong-Kong was then about 8° to 10° cooler than Manilla.

The climate of Manilla and the island of Luzon generally may be described as fairly healthy for the Tropics, certainly not as deadly, and probably on the whole less trying, than Hong-Kong, in spite of being farther within the Tropics. The adjacent island of Mindoro is, however, so fatal to European life that Englishmen never go there.

An easy journey of two and a half days by steamer takes the traveller from Manilla to Hong-Kong. The first sight of that island is very striking. The rock on which it is built springs straight out of the water,

and as we saw them the hills of the adjacent Chinese coast looked more than their height through the rising morning mist. The houses are large and solidly built of stone, while zigzag paths are seen mounting the hill to the signal station on the summit of the peak. The town is so much under the hill that it was found impossible to get a suitable site for an observatory on the island; the mountain rises to an angle of 23° above the southern horizon, which would have made proper astronomical observations impossible. The meteorological and astronomical observatory is now located at Kowlong, a small patch of ground on the mainland belonging to England, about a mile across the water from Hong-Kong. Unfortunately the site is very unhealthy, for there are paddy fields and undrained marshes on one side of the building; and all the staff suffer either from intermittent or remittent fever. The lower portion of the fine, square, verandahed house is used for the clerical and office work of the establishment, while the upper story contains the dwelling rooms of the director. The transit-room and magnetic instruments are placed in separate out-buildings.

We had a good deal of conversation with the director, Dr. Doberck, on typhoons and weather generally in Hong-Kong. His experience confirms what we had heard before in Manilla, and afterwards in Japan, that typhoons do not differ in general character, though considerably in detail, from the less violent cyclones which traverse Great Britain from the North Atlantic. The centres of typhoons rarely pass over Hong-Kong; they either enter China a good

deal to the south, or else move up through the Formosa channel and recurve up to Japan. Hong-Kong is also very favourably situated for forecasting typhoons, as it is in telegraphic communication with Manilla on one side and with all the China ports on the other. The reports received from these stations are of course the most important factors in framing forecasts, but local observations are also valuable. During the south-west monsoon, while the surface wind comes from south-west, the clouds come from west or north-west; but if the high cirrus should begin to drive from the north-east, a typhoon is certainly approaching. At Hong-Kong we have a system of forecasting hurricanes quite different from that which can alone be employed in Mauritius. Here the forecaster can trace the storm from its origin in the Philippines, and see whether it heads towards Tonquin or the China coast; whereas there Mr. Meldrum is obliged to depend entirely on the changes in his own instruments, and his own observations on the motion of the clouds. Long tufts of light, wisp-like clouds precede the arrival of a typhoon the same as any other cyclone; but in Manilla and Havana they think that these streaks converge directly towards the centre, whereas observations at Hong-Kong do not confirm this opinion.

Hong-Kong when first settled was very deadly to Englishmen, and even now it is decidedly unhealthy. The curious thing is that the fever seems to lie in the granite rock, for whenever any blasting operations take place there is always an increase of the disease. Some of the rock is said to be rotten, which may

partially account for the effects; but here, as in many other places, the origin of intermittent fever is obscure.

In Hong-Kong at this time of year—the end of May—the north-east monsoon has fallen very light, but the rainy season of the wet south-west monsoon has not set in. The city was suffering from the effects of drought, as no rain had fallen for a long time, and water was being retailed in the streets at a high price. The weather was very hot, and the sun burning in the middle of the day, for the few cumuli which formed did not suffice to give any appreciable shade. The air was relatively dry, though the total amount of vapour in the atmosphere was considerable.

We left Hong-Kong on the 25th of May for a seven days' run by steamer direct to Yokohama in Japan. Meteorologically the voyage was of considerable interest. Hong-Kong is just inside the Tropics, and the sky and climate are characteristic of those regions; but when two days out a new system of skies and clouds appeared. The soft, detached, rocky cumulus with the light, feathery cirrus at a higher level were replaced by stratiform, or flat layers of more or less broken cloud so commonly seen in England. We also had the rare experience of a gale caused by a small depression forming actually over our heads; but by the time we arrived in Yokohama the weather had cleared up.

About a fortnight was spent in Japan, with Yokohama for headquarters from which to make excursions to the various places of interest in the neighbourhood.

This part of Japan is rather flat, with very irregularly-shaped mountains up to 2000 or 3000 feet rising at intervals along the horizon. The baths of Miyanosta, about fifty miles south-west of Yokohama, are a favourite resort both of Japanese and foreigners during the hot summer months. From there we tried to make a trip round the neighbouring lake of Hakone, but were prevented by the weather. All our party were struck by the similarity of the scenery to that of the south of Scotland, consisting as it did of bare grass-covered hills, with wind and rain and mist driving over them and us. The mist on the hills was also of the true northern type; the cloud formed a straight line across the mountains at a certain level, and the lower edge seemed to trail or drag along the ground as the whole drove before the wind. This was quite different from the Himalayan mists, in which the clouds formed themselves round the mountains as the vapour-laden air from the plains of India was deflected upwards by the steep slopes of the mountains. A most striking feature in the landscape on the road to Miyanosta, and from the hills round the lake of Hakone, is the fine volcanic mountain of Fujiyama. The name signifies in Japanese the "peerless mountain," and the snow-clad cone towers above the rest of the hills. Pilgrims go in hundreds every year to the summit, some 13,000 feet above the sea; and the mountain is a common object in Japanese landscape paintings. Of course the beauty is exaggerated by people who have nothing similar with which to compare the size and shape. The highest form of

mountain beauty is certainly not to be found in a volcanic cone; the form is too symmetrical and geometrical to completely satisfy the eye. Fuji is a perfect barometer to the fishermen on this part of the coast; they study closely the aspect of the giant, and whenever he is seen, as they say, to "wear his cap," they look out for squalls, and the tiny fishing boats are to be seen scudding homeward for their lives. This of course refers to the cap of cloud which covers most mountain-tops before rain, and which is familiar to every Englishman. In bright autumn weather the entire slope of Fuji is generally distinct at sunrise. Towards noon a few clouds appear round the crest, a little below the summit, and form themselves into a ring which encircles the peak till evening, when they disappear after taking part in the colour display of sunset. In Switzerland they call this circle of mist the collar of a mountain; and there, as here, the "collar," as distinguished from the "cap," is a sign of fine weather.

At Yokohama I at last found time to have between three and four dozen photographs developed which I had taken in Borneo, and some of which illustrate this book. The result brought forcibly home the well-known fact that photography is very slow in the Tropics, although the light appears strong and bright. Few, of which the exposures had been so long that a cap could be used, were underdone, as I had taken care to give plenty of time; but all attempts at instantaneous photography with a snap shutter failed, with one exception, from under-exposure. The reason is un-

doubtedly to be found in the enormous absorption of the sun's chemical rays by the large amount of vapour ever present in tropical air. The spectroscope shows this partly by the thickness and darkness of the rain lines near D, and of the alpha and a lines, all in the yellow and red; but, curiously enough, there is very little apparent difference in the appearance of the blue end of the spectrum. In cloud photography the best results are not got either near the Equator or the pole, but in middle latitudes; and the greatest rapidity is certainly found in the same countries as those in which the best clouds are taken. In northern climates there is the weak power of a low sun to contend against, as well as the effects of haze and fog; while near the Equator the absorbent power of water vapour often makes the exposure too long for successful instantaneous photography. A cubic foot of air in Colombo will often contain twelve grains of water vapour, while the same volume of air in Italy will not hold more than two or three grains of the same water stuff.

Nothing alters more during travel than one's ideas of language. The foreign tongues we usually learn—Latin, Greek, French, German—are all of the same class, and one comes to think that all languages must contain the same ideas, and modify their crude roots by declensions and conjugations of the same type. But in many parts of the world one comes across languages in which ideas that we think fundamental are absolutely unknown, or in which complications that at first seem inexplicable to us are in daily use.

For instance one might think that the word "I" was a simple primary idea; metaphysicians argue about "I" and "not I," or say that because "I stand," therefore "I am." But what would they say to a language like Japanese, in which there is no simple word for "I" or "you," or to one in which the idea of "am" can only be expressed by a circumlocution? It is manifest that the whole intellectual development of man is controlled by his power of language, and that without words there can scarcely be more than general ideas.

In Japan, "I" has to be expressed by simple nouns, whose original significations are in most cases perfectly clear, such as *boku*, servant; *shin*, subject; *sho-sei*, young; *sore-gashi*, a certain person; while instead of such rather self-depreciatory epithets, "you" is represented by complimentary terms such as *Hei-ka*, beneath the steps of the throne, or your majesty; *Kakka*, beneath the council chamber, or your excellency, and so on. The idea of the verb "to be" has to be expressed according to the context by *soro*, literally, to be in attendance as on a feudal lord; *viu*, to dwell; *suru*, to do, and by other words.

This phase of speech must be referred to the infancy of language, for in England a child would be more likely to say "baby hungry," than "I am hungry."

Then in Japanese, as in other semi-savage languages, there is a curious mixture of simplicity and complexity. Nouns have neither number nor gender, such distinctions being utterly foreign to the spirit of the language. On the other hand, the adjective has a

very intricate system of voices and moods like a verb, while the verb itself has an equally complex set of tenses, including four different pasts, besides conditional, hypothetical, optative, and concessive moods. The last four, applied to the verb to go, would be in English—as or since I go—if I go—oh that I could go—even if I go; and in Japanese, *yukeba*, *yukaba*, *yukabaya*, *yukumo*, respectively. At the same time there is no distinction of person or number in the different tenses; therefore "I, thou, he, she, it, we, you, they go," are equally expressed in Japanese by the one word, *yukeba*.

We remarked in Fijian an almost opposite variety of complication, number and person being minutely marked, while tense or mood is hardly known. There are also singular, dual, trial numbers, with an extremely complex system of inclusive and exclusive pronouns running through all three. For instance, the English expression "Let us go," addressed by one person to another in presence of a third, is equivocal. It may either mean "Let you and I go," excluding the third party, or "Let us all three go together." In the former case a Fijian would use the exclusive dual pronoun, while to convey the latter impression he would use the inclusive pronoun of the trial number.

Modern Malay is probably the simplest language known. There is in it neither number, gender, mood, tense, declension, nor conjugation. When you know the vocabulary you have only to string the words together; and there are no troublesome irregu-

lars as in English. However, the language was not always so, for in what is called High Malay there are more complications, and even in the Bazaar language there is still a relic of a former intricate system in the retention of one inclusive pronoun.

The climate of Japan in the month of June is very pleasant after the steamy Tropics—cool, but not cold; warm, but not hot. Next month, they said, was very different; then the air is so damp that everything sweats and spoils from damp. Boots left out a single night are covered with green mildew by morning; paper of all kinds becomes limp, and there is the greatest difficulty in keeping the bearings of delicate instruments free from rust. Winter, on the contrary, is very cold, with north and north-west winds blowing off the frozen plains of Mongolia. It is this which doubtless causes so little tropical, or even semi-tropical, vegetation to grow in Japan. Yokohama is nearly in the same latitude as Auckland, New Zealand; but, except for a few bamboos and palmettos, the vegetation of Japan might be seen in England, while the jungle of New Zealand is nearly as tropical as that of Fiji. It is not the mean temperature of a place which impresses the vegetation so much as the extremes of heat and cold; the frosts of Japan kill many plants which flourish in the winterless climate of Auckland, though the average temperature for the whole year is nearly the same.

On the whole, Japan is tolerably healthy for Europeans; there is a good deal of dysentery, but very little intermittent fever, though they sometimes

suffer from a curious illness which appears to combine the symptoms of remittent with those of typhoid fever. Perhaps this is an ally of the fever which sometimes precedes dysentery.

One of the most interesting excursions in the whole of Japan is to the temples of Nikko, some ninety miles to the north of Yokohama. Eighty miles are along the flat, while about ten more mount the hills among which the village stands. The scenery and manners of the people are typical of the country. Everywhere everything is small and on a baby house scale. Small people, small fields, small horses, tiny houses, tinier rooms, and still more tiny charcoal fires. Wood and paper are everywhere; there is no stone, no glass; nothing turns on hinges, everything slides to and fro—the doors, the windows, the very partitions of the rooms. The charm of travelling in Japan is in the pleasant and courteous manner of the people. They smile and laugh at everything like children, and are helpful and willing under all circumstances. There is an element of quaintness in everything they do, and in all their work. Their toys are familiar to everybody in Europe; here in the streets you see men selling gauze boxes full of fire-flies, gold fish with many tails, dwarf trees trimmed into fantastic shapes, and similar odd conceits. At the same time they are profoundly immoral in one sense of the word, and have little idea of the commonest decency. They think no more of an indiscretion than of drinking a cup of tea.

On rising from the flat ground and paddy fields

into the hills, one is introduced to another special characteristic of Japanese scenery—the long avenues of a kind of cedar known as *cryptomeria.* This tree is remarkable for its straight, branchless stem ; and the vertical cracks which seam the bark greatly enhance the appearance of height. The light colour of the small leaves contrasts pleasingly with the darker hues of the surrounding foliage, and the long, green alleys, stretching for miles along the roads, are a striking feature in the landscape.

The volcanic origin of the hills explains their sharp irregular form, and the absence of any regular grouping. The village of Nikko lies on one side of a stream among these hills, surrounded by cryptomerias, but not suggesting a commanding site for gorgeous temples. These latter are all on the opposite side of the stream, but are invisible from the village. The ground is so irregular and so covered with cryptomerias, that it is almost impossible to give any broad idea of the lie of the various temples. However, you cross the stream, and see a few yards above you an unused bridge, painted with red lacquer, and resting on two stone piers in which the builder has tried to copy a wooden trestle in stone. Of course the latter material is totally unsuitable for the strains of such a structure, and one pier has already given way. It is a general principle in the history of architecture, that when stone replaces wood as a building material, the designers always copy wooden forms instead of inventing a new style to meet the requirements of the new material. A beam or cross piece of stone is the

weakest form in which that substance can be used, and is never employed in modern times.

A striking feature in every Japanese landscape, and of the Nikko temples, are the so-called torii—a sort of arch at the entrance of every temple. In the simplest form this consists of two wooden uprights slightly inclined towards each other, a cross piece surmounts the whole, and just below it a beam is passed through the two uprights and projects a little beyond them on either side. These torii may be of any size from about 4 feet high to as much as 20 or 30 feet; and sometimes a whole avenue of them leads up to the door of a temple. In many cases, as in the grand example at Nikko, this form is exactly copied in stone, including the wedges of the lower cross piece.

A whole chapter might be written on the manner in which Japanese architecture is the expression of the wants, faculties, and sentiments of the race, as modified by climate and materials at hand. There is a considerable rainfall in the country; but this is almost exclusively confined to a season of about six weeks, from April to June. The winters are cold, when shelter is indispensable; but the summers are intensely hot, when a building should allow the freest circulation of air. Japan is also a land of moderate earthquakes and earth tremors, so that the style of construction must be adapted to resist shaking.

This accounts for the lowness of nearly all the buildings, and for the preference given to wood instead of to stone and plaster. The peculiar swayed-down,

curved form of the roofs is the development of the primitive times, when a fabric thrown over a horizontal pole formed a tent or junk covering; and even now the capitals of columns are decorated in many cases with imitations of skins or fabrics draped round them.

Returning now to our bridge over the stream at Nikko, we begin to mount a steep hill, and turn into a temple which contains three gigantic images of Buddha side by side. Leaving this, and passing a little to the left, we see to the right of us flights of steps leading under torii, and through a series of magnificent gateways to and through the courts of the temple and mausoleum of a shogun or tycoon called Iye-yasu. On the left a straight path diverges at an angle of 45°, and leads to the temple and mausoleum of another tycoon, Iye-mitsu. These are the two great sights of Nikko, to which all others are subordinate. Both these are built after the design of every other Japanese temple, which always consists of a series of elaborately-carved and painted gateways leading into as many successive courtyards till the oratory at the far end is reached. Here, at Nikko, the longest direction of the courts is square to the slope of the hill, and they are so far dug out of the mountain that behind the oratory the earth has to be retained by a massive wall of hewn stone. Otherwise the gateways and sacred buildings are all of wood, elaborately carved, and painted in gorgeous colours with lacquer. The whole is set in a forest of green cryptomerias, and represents Japanese art as applied to the materials of the country.

There are certain things common to all decorative art, apart from building construction: plain, flat surfaces must be covered with something to relieve their nakedness, and the ornament must be subservient to the design and material of the edifice. The Japanese have accomplished this with as much skill and success as has ever been achieved by the best artists of France or Italy. The pictures and carvings on the wooden walls, the delicate way in which a little star pattern relieves what would otherwise have been a plain, flat wooden surface, and the harmonious colouring of the square recesses in the roof, have never, I believe, been surpassed. The true mausoleum stands above the big stone wall just mentioned, but for some reason it is only reached by a long flight of narrow steps which issue from an insignificant side door. One would have expected a broad staircase in line with the rest of the building.

The mausoleum of Iye-mitsu is similar in design but less magnificent than that of Iye-yasu. Like the latter, it is built square to the hill, and for this reason is not in line with the roadway that leads to the entrance. Like the other, it is set in cryptomerias, but nowhere in Nikko did we see a general *coup d'œil* of the temples. In both, monstrous and gigantic figures usually occupy niches at the side of the gateways. Among these images, at the back of one of the gates of the temple of Iye-mitsu, are two monstrous figures, nearly life size, of the Japanese gods of thunder and wind. The god of thunder is painted red; he has only two toes on his feet, a thumb and

two fingers on each hand. The right is raised as if to hurl the thunderbolt it holds; the left hangs by his side with another dumbbell-shaped bolt ready for action. It is curious to see how similar natural phenomena have suggested the same idea to different races far apart. In Norse mythology Thor throws his hammer, while in Greece Zeus also hurls a thunderbolt, usually a sort of faggot with zigzag ends. Horace talks of the red right hand of Jupiter, so that not only the imagery but even the colouring are alike. In an early stage of mental development a thunderbolt could not be supposed to fall unless some person had hurled it; and the red colour is evidently suggested by the ruddy or coppery clouds which are usually associated with a thunderstorm, while the zigzag ends were probably suggested by the forked lightning.

The god of wind is painted blue; he has a grinning, grotesque, rather malignant face, with only two toes on each foot, a thumb and three fingers on either hand. A long narrow bag, like a big sausage, rests across his shoulders, and one end is held in each hand. Here is represented the idea of almost every savage race, that wind is shut up or released from a bag at the will or caprice of some deity, usually of a malicious character. The wind bags of Aeolus are almost proverbial, and the comparative mythologist could supply a dozen similar instances. The blue colour, if not a mere fancy of the artist, may also have a suggestion in nature. One of the gateways in the other mausoleum is ornamented with gigantic figures of demons, all painted blue, and the expression of the

wind god certainly suggests a malignant, not a beneficent being. If so, we have the same idea among ourselves. We all talk of "blue devils," or of a "fit of the blues," and both these expressions have a realistic origin in the dark or sombre blue tint which either real objects, or the ghostly creations of a disordered mind, assume under the influence of certain low forms of nervous depression.

The name of Nikko, says Mr. Satow, is derived, according to popular account, from periodical hurricanes in spring and autumn, which issued from a great cavern on the neighbouring mountain of Nan-tai-zan. In the year 320 A.D. a priest, Kukai, visited the spot, made a road to the neighbourhood of the cavern, and changed the name of the range to Nikko-zan, or Mountains of the Sun's Brightness, from which moment the storms ceased to devastate the country until the present time. A cavern situated high up on the face of an inaccessible cliff, just beyond the hamlet of Mma-gayeshi, is still pointed out as the cave in question.

But let us now turn from such folk-lore, and such ancient beliefs in the personality of weather gods—though the latter are only 250 years old—to the Imperial Meteorological Observatory of Japan in Tokio, where weather charts and forecasts are now issued three times a day. We shall then be better able to measure the distance between ancient and modern thought, even if it be more difficult to understand the attitude of mind with which our ancestors regarded natural phenomena.

The offices and instrument rooms are situated on the ruins of the ancient castle in the highest part of the town. The director and officers of the forecasting department received me with the utmost courtesy, and showed me the whole working of the establishment. Among the principal instruments is a King's barograph on a very large scale, but, in spite of the size, the error varies both with the rapidity and direction of the motion of the mercury, evidently from the effect of friction. Adjoining this is a small Redier mercurial barograph, which in some ways works better than its bigger neighbour, and also a Rysselburg meteograph, which engraves on a plate the height of the barometer, wet and dry bulb thermometers, with the direction and force of the wind at every hour for about a week without disturbing the instrument. The outside standard thermometers are exposed in a big Stephenson's screen, while the working anemograph is the well-known Beckley's Kew pattern which always records so accurately.

More novel were the earthquake-recording instruments. The older patterns used on Vesuvius were found to be not sufficiently delicate for Japanese earth-tremors; and much ingenuity and science has been expended on the production of instruments which shall measure correctly both the back and fore as well as the up and down motion of an earthquake. Here the back and fore, or lateral movement of the earth in a quake, is usually only from $\frac{1}{12}$ to $\frac{1}{8}$ of an inch, and a motion of $\frac{1}{6}$ inch does a good deal of damage. All the new instruments record their traces on smoked

glass or paper, which is the most delicate method of self-registration at present known. The greatest inconvenience the earthquake usually causes is the stoppage of the standard clock when the direction of the shake is across the line in which the pendulum beats. This could doubtless be overcome by some adaptation of the escapement to circumstances. The weather-forecasting department is very complete and efficient. Three times daily, at 6 A.M., 2 P.M., and 9 P.M., observations from thirty stations in Japan, and from one in the Corea, are telegraphed up to the central office, all ready corrected for instrumental and other errors. The figures are then marked on a chart, and lines of equal pressure and temperature drawn in the usual manner. The officer in charge also marks on subsidiary maps the amount of change that the various elements have undergone in the past twenty-four hours, or since the last report, according to circumstances. With the chart for the moment, with those of change to assist him, and, above all, with his own experience and knowledge of the ways of weather in that country, the forecaster is often able to see very accurately the course of the weather system then existing, and issues his indications of the future in accordance with his opinion. It cannot be too generally known that weather changes never are, and never can be, calculated like eclipses or the return of a comet; but that the experience and personal skill of the forecaster are always of primary importance. The most successful forecaster in England would be a failure in Japan till he had learnt the

nature and ways of Japanese weather and cyclones; and the best man in Tokio would be useless in London.

The Japanese weather system offers much of interest to the meteorologist. At home, in winter especially, the highest pressures are usually to the east or south-east of our coasts; in Japan they lie in winter invariably to the west or north-west. This, and the lower latitude of course, profoundly modifies the whole course of cyclone motion, and consequent weather sequence, so that many theories which have been started on a limited experience of European countries would never have been propounded had their originators studied the Japanese weather-charts. The meteorologist, like the geologist, must travel much, or he will mistake local facts for general principles, and will never be able to take a broad view of the science he represents. The observers for the Japanese Meteorological Office are men who do nothing else; the custom of this, as of other thickly-populated countries, like India, does not permit any one to do more than one thing. They are paid at the rate of nine yen, or about thirty shillings a month, or £18 a year; while the English Office gives a telegraph clerk a bonus of £3 a year for taking two observations a day in addition to his regular work.

An inspection of the office charts leads us to conclusions as to the nature of weather very different from those of the builders of Nikko. We find that the weather in Japan is of a purely non-tropical type, and that, like our own, the changes from day to day

are the product of the passage of series after series of barometric depressions, or small cyclones, of variable intensity. The details are totally different from those in England, and have no European equivalent. The percentage of success attained by the forecasts is about 70 per cent. This is considerably less than that claimed by most European and by the United States Offices; but a great deal depends on the standard by which success is gauged. I had not time to compare the Japanese system with our own. Their experience differs in one curious point from that of all European forecasters. They find wind more difficult to forecast than rain; we are usually right as regards wind, but often fail to tell of approaching rain. The charts show the reason at once. Japanese cyclones are usually very shallow, and often have not more than $\frac{1}{10}$ of an inch of depression. Local causes can easily override such shallow gradients, and modify both the direction and force of the wind in an unexpected manner. Curiously enough, the forecasters do not find any trouble from the complication of land and sea breezes. Experience has proved that in England no serious gale can blow unless there is a difference of pressure amounting to $\frac{1}{2}$ of an inch between some two places in the United Kingdom. Such a gradient can never escape detection, and is associated with wind which is too strong to be affected by local causes. On the other hand, those ill-defined types of pressure distribution, when heavy rain comes on without any fall of the barometer, which are the bugbear of the European forecaster, do not appear to develop in

Japan. Rain rarely falls there without some measurable depression.

The character and surroundings of a tropical cyclone have already been explained so fully, when describing the hurricanes near Mauritius, that it is not necessary to say much about the typhoons of the China seas, which are exactly of the same nature under a different name. The word is said to mean simply strong wind in Chinese; and modern research has shown the circling and shifting character of all these storms. We had now followed the typhoons from their birth in the Philippines to their death on the coasts of Japan; and, from conversations with all those directly charged with the observation of these commotions, and study of their published reports, were able to form an accurate idea of the nature of these hurricanes. A full account of the relation between tropical and extra-tropical cyclones will be found in Appendix IV; only the results need be stated here. A tropical differs in no essential from an extra-tropical cyclone, as far as shape and circulation of the wind at all levels is concerned. There is the same oval form, the same variable incurvature of the wind, the same relation of the drift of the clouds to the wind on the surface. But some of the details differ considerably. In tropical cyclones the contrast between the heat in front and cold in rear is neither so marked as in higher latitudes, nor is there the sudden change of weather as soon as the barometer begins to rise at any place; but all these features exist in a modified degree. That small, strange, calm

spot in the centre of a typhoon, where only a few white cirri are seen on the blue sky overhead—but dark, heavy, threatening clouds are banked up all round the horizon—is unknown in extra-tropical cyclones; but I obtained evidence that points to the conclusion that its absence is partly due to the increased speed which a hurricane acquires as soon as it has got well out of the Tropics. In Japan they find a clear centre in the July typhoons, which move slowly, and not in those later on in the season, which travel at a quicker rate.

All accounts agree that typhoons in the China seas are not quite so dangerous as those in Mauritius, or even as in the Bay of Bengal. The former move so quickly that, though the wind blows furiously during their continuance, a ship is rarely exposed to their influence for more than twelve hours. How different is this from the hurricanes near Mauritius, that often only move a few miles an hour, and which seem to suck ships into their vortices, and toss them about for two or three days together!

Taking the world all over, the most violent hurricanes appear to be those of the West Indies and the Mauritius; then would come the October cyclones in the Bay of Bengal, and next to them the typhoons of the China seas. The May cyclones on the Indian coasts, and the rare hurricanes in the South Pacific, from New Caledonia to Tahiti, might probably be classed together as of a secondary degree of violence. Cyclones in the Arabian Sea and on the west of Mexico are so rare that one cannot generalise upon

them; and then the list of hurricane countries is exhausted.

Much has been written about handling ships in hurricanes, and elaborate manœuvres described which they are to perform near the centre of a typhoon. Many a ship has been saved by skilful sailing on the outskirts of a cyclone, and even after the characteristic squalls and driving rain have commenced. But when nearer the centre, she gets into the kernel, as it were, of the hurricane, and the wind comes in great guns which no canvas can withstand, when the roaring of the wind is so tremendous that no voice can be heard, when the sky, and cloud, and spindrift are mixed up indistinguishably from one another in a general darkness,—then it is as impossible to give an order as to obey it; and the sailor can only hope that her timbers may not open so as to spring a leak, and that her steering gear may hold, so that she may not broach to and be overwhelmed by the waves.

CHAPTER XXII

TO AMERICA: A MOUNTAIN OBSERVATORY

We left Yokohama on the 12th June for a very uninteresting voyage of sixteen days to San Francisco. We took the great circle route, which saved 250 miles of distance, but ran us when half way across almost up to latitude 49°. The cold was remarkable for this latitude in the middle of summer; and hardly as far north as the Scilly Islands, the thermometer for several days ranged from the freezing-point to four or five degrees above it. Afterwards we experienced little but east winds and calms, with fogs and dull gray weather, so on the whole we had a cheerless time of it.

The weather improved as we approached the American coast, and we ran into San Francisco harbour before a cold bright north-west breeze, under an almost cloudless sky. This cool nor-wester is one of the characteristics of the Pacific coast of the United States in summer time, and adds greatly to the amenity of the climate. Here, in the same parallel as Seville or Sicily, the summers are never unbearably hot, for the morning fogs and cool day breeze

keep the temperature at this season 20° to 30° below that of the scorched plains of the interior of the continent. In winter time a more westerly wind blowing off the sea destroys the frosts, which often reach 60° below the freezing-point on the dry prairies of Idaho and Montana.

The railway journey from San Francisco to New York cannot be done in less than six days and six nights of uninterrupted travelling; but no one would go through without breaking the passage unless very much pressed for time. Our principal object *en route* was the highest mountain observatory in the world on the top of Pike's Peak in Nevada; where, at a height of 14,147 feet above the sea—only a little less than the top of Mt. Blanc—the United States Signal Office maintains a staff of observers for meteorological purposes.[1]

But on the way there we had an opportunity of seeing several very interesting places. After leaving the flat land which lies along the coast, the railway mounts by an elaborate series of zigzags over the Sierra Nevada, and then descends a little into the great basin, 4000 or 5000 feet high and some 400 miles across, which separates that chain from the Rocky Mountains.

Here we found ourselves in a climate and surroundings totally different from any which we had heretofore experienced. As far as the eye could reach we saw nothing but a flat undulating country covered

[1] Since this was written the observatory has been disestablished owing to want of funds.

sparsely with the monotonous bluish-gray bushes of *Artemisia* or sage brush.

Sometimes the ground formed shallow saucers, which, evidently full of water in the winter, were now dry and white with an efflorescence of salt and soda. The whole looked indistinct as seen through a dusty air that was quivering with heat under a cloudless sky and a burning sun; while here and there little whirlwinds raised pillars of dust, which stalked along in the distance. Small oases of bright green grass broke the monotony of the scene at long intervals, where the irrigation round a station allowed vegetation of a new kind to spring up; but on the whole the twenty-four hours' journey across the so-called alkali desert was dusty and disagreeable.

Still I thought that on the whole the barrenness of the desert was exaggerated, for the sage bushes grew sufficiently close together to leave but few large patches absolutely devoid of vegetation. The scene resembled somewhat the desert of Suez, but we miss the long prickles of the camel thorn, and the American soil is more dusty than the sands of Africa.

But the difference of the inhabitants was far greater than that of the country. Occasionally we saw some of the natives belonging to the Paiute tribe lounging and begging about the stations. They were big, clumsy, red-skinned men, with oblique eyes and long, lank, black hair, who struck several of our party as bearing a certain likeness to the New Zealand Maoris, but were as unlike the tall, thin, proud Bedouin Arabs as two sets of men well could be.

Possibly the climates of the two deserts may have much in common during the summer months; but while the freezing-point is rarely reached in Egypt, 30° below zero is no uncommon cold on the plains of Nevada and Utah.

At the eastern border of this great basin we come to the Great Salt Lake of Utah and to the city of that name. It is very curious to see several lines of natural terraces running round the mountains that border one side of the lake, for each of these tells an unequivocal story of a steady drying up of the water.

The only interest of Salt Lake City itself lies in the peculiar domestic institutions of the Mormons. Polygamy had been denounced by the United States authorities at the time of our visit, and plurality of wives could only be indulged in by stealth, so that externally the town scarcely differs from any other Western city.

The inhabitants point with just pride to the results of the occupation of their territory, and tell how they have turned a howling wilderness into a land flowing with milk and honey. But when men—whose crest is a beehive, and whose motto inculcates the necessity of work, and who, though essentially a religious community, lay down the maxim that no one must live by the Church, but by the labour of his own hand—begin to cultivate a virgin soil, they must progress to a certain extent.

The whole experience of the world is to the effect that plurality of wives does not develop the fullest energy of men; and it is perfectly certain that any

other set of emigrants would equally have brought a great deal of desert into luxuriant cultivation. If the northern half of the Utah valley could have been settled by Mormons, and the southern half simultaneously by people living under the ordinary conditions of western civilisation, then the good or bad of their respective domestic institutions could have been accurately gauged.

We have been told that the peculiar combination of high dry air, with hot summers and cold winters, is invigorating to men and soothing to women, and that may have had something to do with the partial success of the Mormon institutions. But a great deal more is probably due to the nationality of the community, for the Mormons are almost exclusively recruited from natives of Northern Europe with a sprinkling of Welsh and true-born Americans. Customs and habits which work well with cold Teutonic blood would be difficult with the fiery temperaments of Southern Europe, and absolutely impossible with the children of nature from the Pacific islands. The idea was once suggested of transporting the whole Mormon community from the territory of Utah to the Marquesas, but the relaxing, debilitating climate of these islands would sooner or later have sapped the energy of the men and degraded them from bees into drones; whilst the admixture of a race whose ideas of life were absolutely contrary to those of a Mormon elder, would inevitably have led to a complete breaking up of the Church and its peculiar domestic institutions.

We left Salt Lake City for Pike's Peak by the Den-

ver and Rio Grande Railway route, which traverses some of the most characteristic scenery of the American continent, as soon after climbing the mountains which border the eastern edge of the Salt Lake, it enters a vast tract of flat arid country produced by the so-called "*Mesa*" or "table" formation of the rocks. There, at an altitude of 8000 to 10,000 feet, all the rocks lie in flat beds, and any undulations take the form of steps in the land and not of rounded hills, and what rivers there are flow at the bottom of deep cañons. A cañon differs from an ordinary valley in having the sides almost perpendicular instead of sloping more or less steeply outwards, like the letter V. In the very extreme case of the great Colorado River, the top of the cañon is only 300 or 400 yards across, and the stream, which covers the entire bottom of the valley some 6000 feet below, is not more than 50 yards wide. The railway crosses this river higher up in its course, where these features are much less pronounced; but runs for some miles down the bottom of a cañon of the Arkansas River, with purple cliffs rising on either side for 2000 feet, and in one place the track has to be carried on girders stretched right across the river, and let into the rock on either side of the stream.

These remarkable cañons are produced by a particular combination of rock formation with certain peculiarities of climate. The rock beds of the district must have been upheaved some thousands of feet without crumpling or distortion, and the climate must be almost rainless; while the rivers which tra-

verse this plateau must be fed in their upper waters by a considerable rainfall or by melting snow.

This is exactly what we find in Arizona and the surrounding districts. That territory is in the almost rainless belt which surrounds the earth just outside the northern tropic; the Mesa formation is hard and well-developed, while the great Colorado River, flowing from the north, is nourished by the melting snows of the Rocky and other mountain chains. Rainlessness is indeed a necessity along the banks of a cañon, for otherwise the steep sides would soon get worn away into the usual V-shaped slopes of an ordinary valley.

The lower Nile, which lies in the same dry belt of the world as the Arizona, forms no cañon, because the rocks of the Lybian desert have not been raised in a suitable manner, or else the rainlessness of Egypt, and the abundant rainfall in Abyssinia would certainly have allowed that great river to carve out a magnificent gorge.

After spending two days and one night in traversing this curious region, in a generally westerly direction, the railway suddenly runs into the level prairies near the city of Pueblo; and then, turning north, skirts the foot of the Rocky Mountains for a few miles till it reaches Colorado Springs at the foot of Pike's Peak.

Six miles in an easterly direction along a short line of rail, brings one up to the little village of Manitou, which nestles in a narrow valley at the base of the Peak. The view *en route* is very striking.

Behind, the wide-reaching prairie, which appears as though it were level, really slopes insensibly from an altitude of 5000 feet towards the far-distant Mississippi. In front, just before reaching the village, a thin layer of hard rock has been tilted straight up like a wall, and one sees the mass of the Rocky Mountains, with Pike's Peak towering above, between the apertures caused by weathering, as if one were looking through a great stone window. All round this curious tilted wall the rocks have been much distorted, and assume so many fantastic forms that this district is known to local topography as "the Garden of the Gods."

There is always something grand in the spring of a mountain chain from a plain; and, though this view cannot compare in many ways with the sudden rise of the Himalayas out of the plains of India, still the obvious manifestation of force in the upheaved rocks is very imposing.

Photograph VIII shows well the wall-like line of rock, and the highest point of the snow-clad chain is Pike's Peak; but a more effective general view is obtained from a point a little nearer the break in the rocks which we see in the foreground. The village of Manitou lies behind the wooded hill below the Peak.

The ascent of Pike's Peak from Manitou can easily be made in five or six hours on horseback; for, though the summit is nearly 14,150 feet above the sea, the village itself is over 6000 feet, and an excellent trail has been made on which to carry supplies

NORTH BORNEO A

D THE PHILIPPINES.

Stanford's Geog.l Estab.t London

and fuel up to the observatory on the top. For the first two hours the track winds up the side of a steep gorge, amid big rocks and pines, till we come to a sort of step on the mountain side where trees will hardly grow. Then crossing a shoulder of the Peak, the timber line is passed, and the path leads through an alpine meadow, carpeted with many flowers, till all vegetation ceases on the long steep slant over loose dry rocks and stones, with occasional patches of snow, which leads up to the summit.

We paused about a mile from the top to look at the sunset. The long shadow of the Peak lay on the level prairie below our feet, stretching apparently to the horizon, but there were so many clouds about that we did not see a curious effect which is sometimes observed. After the lengthening shadow has reached the horizon, the apex apparently rises into the sky for a few minutes till the sun has fairly set, when the whole appearance collapses. This of course can only be seen in very fine weather, and seems to be caused by the ordinary earth-shadow of twilight being so clearly projected against the sky as to show well-marked irregularities on the surface, as we noticed previously at Adam's Peak in Ceylon.

The top of the Peak is flattish, and covered with nothing but loose dry rocks and stones, without an ounce of earth or a blade of grass. We were immediately reminded of the summit of Ben Nevis, where, at a comparatively insignificant level, an observatory has been established by private enterprise under far more trying conditions than on Pike's Peak.

Here a substantial stone building has been erected by the United States Signal Office for their observers and instruments; and there are a few beds where travellers can rest for the night, and an outhouse at a short distance where their horses can be stabled.

We were now in the highest observatory in the world, 14,147 feet above the sea-level, in the middle of a great continent, and had time to look about us. Outside, a cold parching wind whistled round the building; inside, a stove of the well-known American type rendered the principal room almost unendurable with heat. A room opened out of this to the right, which contained some rough bedsteads, and at the extreme end was a window through which the thermometers could be read without having to leave the building. The other side of the house was occupied by an eating-room and kitchen.

Three men are constantly stationed here, and yet it will hardly be credited that all observations are suspended from 11 P.M. till 3 A.M. or 4 A.M.; and that there is only one self-recording instrument in the whole establishment—a revolving time drum which marks automatically when every mile of wind has passed the anemometer. The telegraph wire from Manitou has been broken for a couple of years, and returns are only sent at stated intervals to the Signal Office in Washington, so it is rather difficult to see the precise object of such an expensive organisation. The observations cannot be used in framing the daily forecasts, and the break of four or five

hours in the middle of the night makes the records useless for most other purposes.

Altogether we were disappointed with the observatory, and could not help contrasting it with that on the top of Ben Nevis, where three men, with the assistance of self-recording instruments, have never missed a single hour for four consecutive years. While the former is administered by a Government department which dispenses $1,000,000 (£200,000) a year, the latter is supported by voluntary subscriptions; but still, as we so often find, the elasticity and freedom of private enterprise can beat the wealthier but more trammelled administration of a public office.

Only about 30 inches of water a year is measured in the gauges here, either in the form of rain or snow. The latter always falls in the dry powdery form, which the Canadians call *poudrée;* so that the instruments are never covered with ice and rendered useless, as so often happens on the top of Ben Nevis.

Sometimes very high winds have been experienced on the top of the Peak, but the lowest temperature noted is only about 30° below zero, which is not much below what has been often recorded on the neighbouring prairies.

But the most striking features of weather at Pike's Peak are the extraordinary electrical phenomena which accompany the approach or presence of thunderstorms. We saw nothing, as the weather was too fine and dry; for, curiously enough, the most startling manifestations are exhibited during slight showers of

wet snow which fall in the thundery weather of the summer months. Every pointed thing in the observatory can then be made to emit electrical sparks —the anemometer, the top corners of the house, or the end of a pole. If the finger is wetted and held up, sparks fly from the tip as if the body had been charged by an electrical machine; and sometimes other sparks jump unpleasantly from the rim of the hat to the ears.

During a thunderstorm the hail crackles as it falls, and sparks can be drawn from the stove-pipe if touched by the fingers. Hair and whiskers are electrified by each discharge of lightning; the former stands on end as the electricity escapes with a hissing sound; the scalp appears to be pricked with hundreds of hot needles, and a burning sensation is felt on the hands and face.

The telegraph wire is naturally much affected. Operators, and those engaged in repairing the line, are often knocked down, or receive shocks of unpleasant violence; and when the transmitters are cut out, a current of electricity passes between the plates of the lightning arrester—not in sparks, but in streams of light as thick as a lead pencil, for two or three minutes at a time.

On one occcasion "the wire, for an eighth of a mile from the building, was distinctly outlined in bright light, which was thrown out from the wire in beautiful scintillations. Near at hand the little jets of flame could be observed very plainly. They were invariably in the shape of a quadrant, and the rays

concentrated at the surface of the line in a small mass, about the size of a currant, which had a bluish tinge. These little quadrants of light were constantly jumping from one point of the line to another. There was no heat to this light, and when the wire was touched only the slightest tingling sensation could be felt. Not only was the wire outlined in this manner, but every exposed metallic point and surface was similarly tipped or covered. The cups of the anemometer appeared as four balls of fire revolving slowly round a common centre; and the wind vane was outlined by the same phosphorescent light."

None of our party who rode up was inconvenienced at first by the rarefied air; but some other visitors who had walked up suffered from the well-known mountain sickness. We could not sleep much, and by next morning we were all suffering from headache, nausea, and general prostration. In bad cases, bleeding from the nose, ears, and finger-nails supervenes; but we did not hear that any case had ever turned out fatally here. The observers suffer like other people, and are usually exchanged every two or three weeks with some of the staff at Colorado Springs. They say that sickness wears off; but if the head is affected, that derangement remains. Some observers never get acclimatised, and are obliged to leave the mountain.

The sensation is certainly very peculiar; you feel that somehow you begin to puff and pant with the slightest exertion, and there is a singular feeling of prostration for which you cannot account. We had

felt no distress at Sandakphu, which is only 12,000 feet above the sea; but the experience of Alpine climbers is that, at about 13,000 feet, most novices begin to be affected rather suddenly.

Next morning we turned out at 4.10 A.M. to see the sun rise. A little purple light glowed on the rocks and stones at our feet, and lit up the under-surface of a patch of strato-cumulus cloud with a mousy-gray tint; while we shivered under the lee of the house, as we tried to shelter ourselves from the cold wind which blew from the south-west, only five degrees above freezing-point.

A little later, a fan of pink crepuscular rays shot up from below the point where the sun himself rose red a few minutes later, tinging the horizon crimson, and the beautifully structured under-surface of the cloud, first pinkish-brown and then full glowing orange. Below the risen sun lay the boundless prairies, and for nearly a third of the horizon, the line of land was as even and round as that of the sea itself, but the atmosphere was so hazy that we could take no photographs. To the westward the air was misty and the sky covered with ill-defined clouds that took little coloration of any kind; while a sea of mountains with broad shallow valleys—here called "parks"—stretched as far as the eye could see.

Our breakfast party was rather a melancholy affair, for we were all so prostrate that we could scarcely drink a cup of coffee; and it was quite out of the question trying to swallow a mouthful of solid food. We rallied as soon as we had descended about

a thousand feet, and could then fully appreciate the striking view before us. The distant edge of the plains appeared to rise towards the horizon till it seemed as if we were looking into a great saucer. This curious effect of bird's-eye perspective has often been noticed by balloonists, but it can only rarely be seen from mountain-tops.

An incident in the descent recalled our Himalayan experiences, for we passed a party going up who had whitened their faces to avoid the burning glare of a July sun. Our guide laughed and said it was not of the slightest use, but it would have been a most interesting experiment to try if the blackening of the savage or the whitening of the civilised man was the more efficacious, or whether both processes were equally valueless.

CHAPTER XXIII

WASHINGTON: WEATHER FORECASTS

The route from Colorado to Washington is so well known that we need not describe it here. At Denver we experienced one of those spells of hot weather known popularly in the United States as a "hot wave." During this period the thermometer rises for a few days to a somewhat unusual height, and then, after perhaps a little rain or thunder, falls to its ordinary level. The air of course—here in the centre of a great continent—is intensely dry. On one of the days we spent in Denver the temperature rose—according to the newspaper reports—to 99°, and the humidity in the middle of the day was as low as 20 per cent of the complete saturation that would have been noted as 100.

But these barren figures convey but a lifeless, poor idea of what a dry climate really is as compared to the humid atmosphere of such an equatorial country as Borneo. In the latter country you sweat at every pore, and the lassitude induced by the greenhouse-like heat makes every exertion an effort; while, in the former, perspiration evaporates so rapidly that it

ceases to be distressing, and, for some physiological reason, dry air has rather an invigorating than a depressing influence. There is no doubt that part of the energy of the American character is due to the bracing climate of the Union.

On our arrival at Chicago we found that some anarchist riots had just been suppressd in a rather summary manner, but even then there were men with loaded rifles guarding some of the engine-houses and railway switches. The newspapers were discussing a recently-published statement that most revolutions or popular uprisings occurred everywhere during the summer months. The question why this should be so was solved by the assumption that great heat fired the brains of anarchists and other violent men, who as a rule are just bordering on insanity.

It is doubtful, however, whether this view is really correct, for under ordinary conditions the insane are not worse in hot weather than at other times. A truer reason is probably the difficulty of keeping a body of men together in cold wet weather, whereas they can leave home with little hardship in a warm dry season. Imagine the difference to a social democrat in London whether he made his demonstration on a cold wet day in January, or on a warm evening in July. In winter it is too cold to stand still for long, and it is well known that a shower of rain acts literally as a wet blanket on an English mob; while in summer the demonstration would be but a pleasant outing, and a relief to the dull monotony of his precarious existence.

The problem of the influence of climate on individual and national character has long attracted the attention of the world. Like every other question, it has gone through many phases. Some have sought to explain all racial differences solely by the long-continued influence of climate on a single original stock, while others have denied that the surroundings or environment of a nation can have any effect on the temperament of the individuals. Now we know, however, that the components of character and conduct are both numerous and complex; and that original difference of race, the severity of the conflict with nature, the history, laws, religion, social habits, customs, and climate, are all factors of the final product. A volume might be written to work out the details of any one of these influences on different races in various parts of the world, but here we may call attention to the manner in which, on the contrary, the energy of the American character has modified the original climate of the Union.

If there is one thing that more distinguishes the modern from the ancient spirit, it is the attitude of mind with which men approach the conflict with nature. In the early stages of civilisation—such as those we have met in India, Fiji, and Japan—people worship the manifestations of nature, and any attempt to modify the supposed order of things is looked on as impious. But now it has been discovered that most of what we call progress and civilisation has been attained by conquering our instincts or surroundings, and nowhere has this struggle been carried

on with more success than in the United States. The pioneers of the western territories found little but sage brush on a dusty desert; or wind-swept prairies, where stock was often reared with difficulty owing to drought and exposure. We have already noticed how irrigation has turned the desert of Utah into a fruitful garden, and here in crossing the plains we saw the long belts of trees that the law in some States has compelled owners to plant, both as shelter and as aids to the precipitation of rain. The influence of trees or forests on rainfall varies considerably in different parts of the world for reasons that need not be discussed here; but in Iowa, for instance, there is most unequivocal evidence that the rainfall is greater over the timbered than over the treeless portions of the State, and there is no doubt that irrigation, plantation, and cultivation have sensibly modified the climate of the Western States.

Our primary object in visiting Washington was to inspect the United States Signal Office, which organises and controls the weather-forecasting system of the Union. General Hazen, the chief signal officer, received us courteously, and, besides giving us all the information in his power, introduced us to the leading heads of departments. Much interest attaches to this office,—by far the largest weather bureau in the world, and the one that devotes its chief energies to the problem of weather changes from day to day, rather than to those questions of climate which occupy the leading place in almost all other similar organisations.

We were introduced first to Professor T. C. Mendenhall, who not only presides over the department that verifies and issues all instruments sent out by the office, but also over the laboratory, where new instruments and new methods of observation can be investigated; afterwards to Mr. Cleveland Abbé, one of the professors of theoretical meteorology, who had just completed a bibliography of meteorological publications which contains no less than 50,000 entries; and lastly to one of the most remarkable men in the United States—Professor William Ferrel.

More than sixty years ago, he, as a young man in a store out among the backwoods of Missouri, found a copy of Newton's *Principia* among a pile of old books. This he mastered, and then sent—which was then no easy matter—for Bowditch's translation of Laplace's *Mécanique Céleste.* This he also mastered so thoroughly that he eventually found employment in the Nautical Almanack Office at Washington; and more than twenty-five years ago he published a new theory of the influence of the earth's rotation on the atmosphere. This theory, after much discussion, has now been adopted in almost every country except England, and has earned for him among his countrymen the title of the "Newton of Meteorology."

We found the professor—a large, elderly, gray-haired man, with a broad-topped head, big eyes, a thoughtful face, and the unmistakable look of an American—busily engaged over the proofs of a new book in a dingy unfurnished room, where there was scarcely room for two chairs and a table. His deaf-

ness made conversation difficult; but it was delightful to listen to the simplicity and earnestness of a man who was pleased, because the only English meteorologist who had taken the new theory up, had so thoroughly appreciated the principles involved, as to detect what the professor himself felt to be a weak point in one of the applications of his system.

I also met Mr. Finley, who has made tornadoes the subject of special study for many years. For some reason or other the United States are exceptionally devastated by these destructive whirlwinds; and within its limited sphere of 200 or 300 yards across, the tornado is more disastrous than the hurricane, and is the most terrific manifestation of nature in the whole range of atmospheric phenomena. Some photographs, not only of the tornado clouds themselves, but also of the destruction wrought by them, were most interesting. The conical spout which forms the body of the whirlwind seemed sometimes to hang down from the clouds, and sway about like an elephant's trunk, and it seemed difficult to realise that so small a whirlwind could lift wooden buildings right up into the air, and even unroof and wreck a substantially built structure of brick.

In another building the instrument room of the office has been located. Here there was a large assortment of barographs and thermographs, with instruments for recording automatically the direction and velocity of the wind, and also delicate electrometers for measuring the tension of electricity in the air. But the most interesting sight of all was the indica-

tions room, where the forecasts of weather are prepared. No one, who only reads in a newspaper a short, clear statement of the probable weather, can have any idea of the enormous amount of labour and organisation which the preparation of that brief sentence has involved.

Three times a day, seventy-five men in all parts of the Union simultaneously read their barometers and thermometers, besides noting the direction and force of the wind, with the appearance of the sky and motion of the clouds.

As often, six other men are waiting in a small room in the Signal Office to receive their reports.

Number one reads out the figures for each station as they arrive through the telegraphic wire.

Number two writes the numbers down with a cyclostyle copying apparatus, so that a few copies of the original records can be reproduced and preserved.

Number three has a much more difficult task. He has before him a large outline map of the United States, and as the observations are read out for each station, he writes them down in the proper place on the map. For instance, suppose he heard called out —New York, 30·0 inches, 79°, S.W. 30, he would mark the barometric height of 30·0 inches in one coloured ink, the temperature of 79° in another colour. An arrow flying from south-west with a little 30 beside it, to denote the number of miles an hour the wind was blowing, all as near as possible where New York would be on the map. This he does for every station, and then waits for a bit to perform some other work,

which we shall describe presently. This is far the most important chart; but to get all the possible use out of it, no less than six subsidiary charts have to be constructed, which requires the labour of three more men.

Number four has two blank maps of the United States on his desk before him; but instead of writing down on them what the barometer actually is at each place, he marks on one map how much the mercury has risen or fallen in the last eight hours, and on the other the amount of change in the last twenty-four hours. From these he draws, as it were, a picture of how changes of pressure are travelling across the country, or of the formation of new storms. He also draws on these two charts lines of what are called equal barometric departure, and abnormal variation; but these represent a refinement of detail that we need not explain here.[1]

Number five has also two maps before him, and draws on them lines of equal changes of temperature, exactly as number four has done for pressure. By means of his charts it becomes easy to trace the progress of what are called hot or cold waves across the Union.

Number six likewise prepares two maps; on one he marks at every station the kind of cloud, and the direction of its motion—which may be very different from that of the wind on the surface of the ground—and sometimes the colour of the sunset. On the

[1] For full details see Abercromby, *Weather*, Int. Scientific Series p. 453.

other he notes the temperature of the dew point, and some deductions from that, which enable him to chart out the position of damp or dry areas of country.

Two hours have elapsed from the moment at which all the observations were taken till they have all reached Washington, and been tabulated and charted as just described; and now the indications officer makes his appearance. It is not everybody who is competent to be an indications officer of the United States Signal Office. Such a man must not only have shown some aptitude for the work, but have gone through a severe course of training for two years, in learning the theory and practice of all branches of meteorology, and in travelling about the country so as to know the local peculiarities of the wind and weather at every station.

The work of preparing forecasts three times a day, at such hours as one and nine in the morning, and two o'clock in the afternoon, is so severe that four men have to take it successively, a month at a time; and each man spends the three months he is off in visiting the different stations, and in doing other less exhausting work in the office.

But let us return to the indications room as the officer enters and finds the six charts more or less ready for his inspection. He first goes to the chart on which number three has written down the readings of the barometer and thermometer, and draws with his own hand lines, called isobars, through all places where the barometer was at the same height, say 30·0 inches, 30·1 inches, and so on; and also another

set of lines with a red pencil through all places where temperature is the same, say 60°, 70°, and so on; and then he walks round the room and looks at the five other charts which are all ready for his inspection.

He is then ready to issue his indications—but why, and how? All forecasting depends principally on the lines we have called "isobars." These map out to a trained eye not only the whereabouts of good or bad weather, but also indicate the future course of wind or rain or thunderstorm. The map which the indications officer drew himself is the primary source of his forecast; the other five charts are only refined and elaborate adjuncts to assist in the formation of his judgment. No calculation is possible; everything depends on the skill and experience of the forecaster.

Some men make up their minds quicker than others; and some seem to form their judgment more by instinct, others by study. The difference between the best and worst is, however, about 13 per cent; that is to say, that if the most skilful got 93 per cent of success, the least skilful would obtain 80 per cent of success. Lieutenant Woodruff, of the United States army, was the indications officer at the time of our visit, and on looking over the verification of his forecasts for one month at one particular place, we found that he had achieved the exceptionally high figure of 93 per cent of success.

As soon as the indications officer is ready he dictates his forecast to clerk number three, who sets it up with logotypes, that is with whole words in

a block instead of single letters. For instance, "*Tennessee*" would be in a single block, and many other common words, such as *and*, *the*, etc. We might be surprised at a man setting up types to dictation, but a forecaster does not speak his carefully-considered sentences at the same rate as an orator like Mr. Gladstone, who perorates at the rate of 120 words a minute.

And now, some two hours and twenty minutes after the observations were taken, the indications are ready to be telegraphed to every city in the Union, and the officer is probably glad to retire to rest, as he will have to turn out again in the middle of the night.

The late Mr. Brassey stated, as the result of his experience in contract labour, that the price of work was nearly the same all over the world. The British navvy who eats three pounds of beefsteak and earns ten shillings a day will do about twenty times the work of the rice-fed Hindoo who toils the livelong day for sixpence. Can the same principle hold for mental labour also? A private in the United States signal corps gets £13 a month, while a Japanese observer gets rather less than £2 for the same period. Both are required to take three sets of observations daily, but the Americans have also to do an immense amount of tabulation and other routine work. It would be both curious and interesting to obtain an exact measure of the quantity of work done by both sets of men, and thus to see whether the highly-paid observer really did more than six times the amount

performed by his competitor on a starvation rate of remuneration.

The Japanese certainly do much less in a day than Europeans. In Tokio none of the native staff can prepare three forecasts a day without being knocked up, whereas one of the Europeans told us that if he had nothing else to do than that, he would be idle half the day. This must not of course be compared with the three forecasts a day prepared in Washington, for those in Japan are not nearly so minutely elaborated as those in the United States.

They told us in the Signal Office that the work of even the privates was so hard that it took all of a good man to stand the strain, and we have no doubt that such must be the case. Holidays are short, for the departmental chiefs only get about twenty days' leave in the year, and one could see the look of hard work on all. We left the office with the conviction that we were saying good-bye to a body of men who were not only striving to do their prescribed work, but, with characteristic American earnestness, were trying to excel, and to carry their several branches beyond the present limits of knowledge.

From Washington we went to New York to embark for home on board the famous steamer the *Etruria*, which has made the fastest passage on record across the Atlantic. The voyage was totally uneventful, for we had nothing but fine weather the whole way. When nearly two days out we ran suddenly into fog and calm, and for the next twenty-four hours were rushing over Newfoundland Banks

at the rate of twenty miles an hour. Two men and an officer were constantly stationed at the bow of the ship peering anxiously not only ahead but also into the sea for fear of floes of ice, and all day and night the fog-whistle screamed mournfully through the gloomy air.

The fog, as usual, was very shallow, for it often did not reach as high as the mast-head, and at night the full moon formed a beautiful white fog bow nearly as large as a lunar rainbow, on the droplets of water in the mist. Rather suddenly also, we ran out of the cold water and fog of the Arctic current into an entirely new climate. All the feel of a hot continental climate that we carried from New York was gone, while a cool brisk air, with a bright crisp sea, reminded us that we were nearing home, and two days later our voyage came to an end at Liverpool.

After a lapse of twenty years it was impossible not to contrast the eighteen days spent in the *Damascus* with the six days occupied by the *Etruria* in running a somewhat longer distance between the two continents, and to reflect on the causes which had so developed naval architecture. Let alone that the 1300 tons of the former had to be set against 8000 of the latter ship, the difference of speed was even more striking. The *Damascus* rarely achieved more than nine knots an hour, or 240 miles in the day, while the *Etruria* does eighteen knots steadily, and, under exceptionally favourable circumstances, has run no less than 535 miles in twenty-four hours.

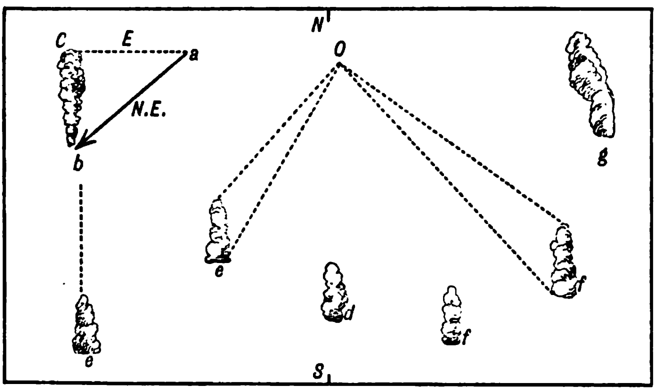
When men are brought face to face with difficulty,

they either avoid it altogether, when any little aptitude to cope with it is soon lost by disuse; or else they rouse themselves to increased efforts, and gradually develop exceptional power of meeting the danger. Fortunately for Great Britain, the stormy seas which surround her have not crushed all maritime effort out of her, except on the western shores of Ireland, and the finest ships and the finest sailors in the world are to be found in her magnificent mercantile fleet that perform with undeviating punctuality the worst passage in the whole globe—that which lies in winter between Liverpool and New York.

APPENDIX I

ON THE ORIGIN OF "TRADE CUMULUS"

If a steamer was running from the north-east with an east wind on her quarter—see the left-hand corner of diagram—the line of smoke left by her funnel would lie about north



ORIGIN OF TRADE CUMULUS.

and south, but float, broadside on, in the easterly current. This is obvious, for the portion of the smoke-wreath which left the funnel when the boat was at *a* would have been wafted to *c* by the time she had arrived at *b*.

Suppose a column of air to commence rising in the north-east monsoon, and just after it got to the level of condensation to come within the influence of the easterly upper current which prevails there at low levels, then the

conditions would be precisely similar to those of the smoke of the steamer. The flat base of the cloud would move from the north-east, while the top was driven more from the east. The resulting patches of cloud would therefore lie nearly north and south, with the flat base on the southern side; while the rocky top would slant vertically upwards towards the north. This is represented at *g* in the diagram, which gives the appearance of a cloudlet viewed from the eastern side. This slant is necessary, because we suppose that the top and bottom of the cloud are not in the same current of air, and that the column continues to rise a little after the first condensation.

An observer at *o*, looking south at a sky dotted promiscuously with these little clouds, would see them all in perspective, so that *d*, which was end on, would stand straight up without any deflection of the top, while all the cloudlets *e e* to the west of him had their tops bent towards the right, and those to the east, such as *f f*, to the left. The general appearance of the sky would therefore be as if the heads of all the clouds slanted outwards from below the south point of the horizon, as in the diagram in the body of the book, p. 48. If the observer turned round and looked towards the north, he would also see the cloudlets directly in front of himself rise straight up, and those on the west would also have their tops slanted upwards to the right, and those on the east to the left. The result would be that the clouds would all appear to converge towards a spot above the north point of the horizon.

APPENDIX II

UPPER WIND CURRENTS NEAR THE EQUATOR

THE popular idea about the circulation of the atmosphere over the Equator is certainly erroneous. It is usually supposed that the north-east and south-east trades meet over the doldrums, and that the air then rises and pours back to the nearest pole. In the North Hemisphere this return current would be from south-west; in the South Hemisphere from north-west.

The result of my own observations in the doldrums of both the Atlantic and Indian Oceans, points to the conclusion that at high levels the two trades rather tend to coalesce into a single easterly current, and that the poleward motion of air near the Equator is very small.

It is very curious that the propagation of the dust ejected by the great eruption of Krakatao in August 1884 confirmed this view. The dust went round the world in a belt near the Equator in about four days, and did not reach middle latitudes till two or three months later.

My results were got by watching very carefully what is technically known as the vertical succession of the upper currents. It has been discovered that there is a very definite succession of upper currents as we ascend from the surface. The atmosphere is not composed of horizontal layers of air moving promiscuously in any direction; but,

as a rule, we find a regular, continuous, successive series of changes in the direction of the wind as we ascend.

Innumerable observations have shown the very definite law of vertical succession of the upper currents. In the North Hemisphere, stand with your back to the wind, and the upper currents will come more and more from your left hand the higher they are. The rule is reversed in the Southern Hemisphere, for there the upper currents come more and more from the right. For instance, with a southerly wind in London, the clouds will come more and more from the west the higher they are, while in Australia they would come more and more from the east.

I found some very interesting exceptions to this general law in the doldrums.

In the West Atlantic, the south-east trade always crosses the Equator, and the doldrums are 5° to 10° north of the line. In this belt I found that the surface south-east Trade had a more easterly current at higher levels; or in other words, that the vertical succession of the Southern Hemisphere was retained.

In the south-west monsoon of the Gulf of Guinea, between the Equator and the doldrums, the south-east trade turned into south-west on the surface, while the upper winds came from south-east or east. They ought to have come from west to accord with the circulation proper to the North Hemisphere.

In the Indian Ocean, during the season when the north-west monsoon blows from the Equator to the doldrums, 10° or 12° south of the line, I found the upper currents over the north-west monsoon always from north-north-east, or even east, whereas they ought to have been from west, to follow the vertical succession due to the Hemisphere.

Hence we see the proof of the assertion, that the trades and monsoons do not meet and force one another to

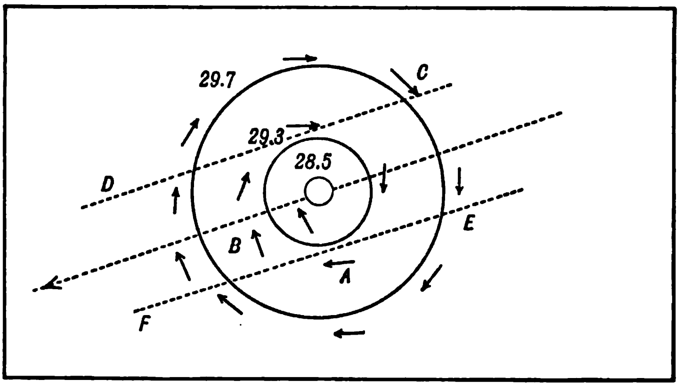
rise and flow back polewards, but that the two winds coalesce to form one great easterly current over the doldrums.

Full details are given in my paper read before the Royal Meteorological Society in June 1888, but not yet published.

APPENDIX III

ON MELDRUM'S RULES FOR HANDLING SHIPS IN HURRICANES

IT has been well known for the last hundred years that a hurricane was in some way the result of the passage of a whirling circular mass of air, 200 or 300 miles across,

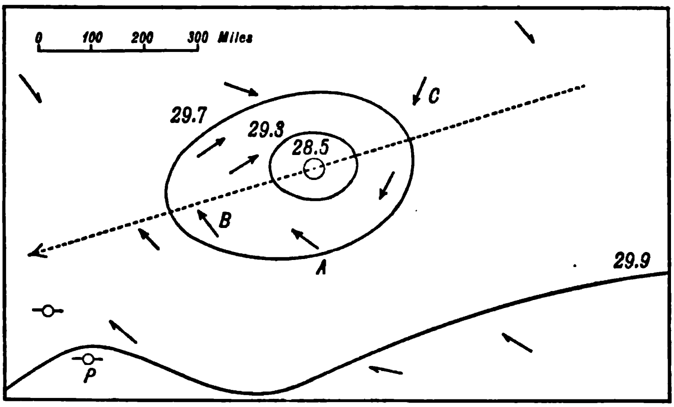


A THEORETICAL HURRICANE.

over a place, but now we know that this crude idea must be modified. Here we give the diagram of a hurricane in the Southern Hemisphere as it used to be drawn by the earlier cyclonists, which is still adhered to by some theoretical meteorologists. A hurricane is there represented by an exact circle, and the whole is treated as an isolated whirl without any reference to the surrounding trade winds.

The wind arrows are drawn everywhere exactly at right angles to the radius of the circle at that particular point, so that if you want to know the position of the centre you have only got to stand with your face to the wind and hold out your left arm square to the front. Your hand then points in the direction of the central vortex.

Here, on the contrary, we give a diagram of a typical real cyclone, which scarcely differs from one which traversed the Indian Ocean on the 9th of February 1816. As



A REAL HURRICANE.

usual we employ isobaric lines, which are marked 29·9 inches, etc., to map out the position and shape of the cyclone and to show the neighbouring distribution of pressure. The long arrow shows the path of the cyclone, the shorter ones fly with the wind whose direction they denote. The point of the arrow marks the position of the ship, the number of feathers in the tail are proportional to the strength of the wind, six being the highest number and corresponding to a force of twelve on Beaufort's scale. The scale of miles at the top of the diagram will give an idea of the dimensions of the hurricane. Roughly speaking, the outer oval isobar of 29·7 inches, 500 miles across the

longest way, would be the limit of the true field of the cyclone, though strong winds would be experienced outside that limit. The inner isobar of 29·3 would nearly define the extent of the inner kernel where the hurricane rages with greatest fury, while the smaller innermost circle, some thirty miles wide, represents the size and position of the central vortex, where the barometer probably marks as low as 28·5 inches. A line between 29·7 and 29·7, which cannot well be drawn here, would nearly mark out the shape and place of the rain which surrounds the patch of blue sky over the vortex, and that of 29·7 would define the limit of cyclonic cloud. Outside that isobar the sky would either be clear or more or less covered with ordinary trade wind cumulus. One hundred to one hundred and fifty miles on the scale would about show the distance the whole cyclone would traverse in twenty-four hours towards the south-east. Surrounding the hurricane we see the north-west monsoon on the northern side, while the south-east trade blows on the southern side, where also the highest pressure lies. Round the hurricane itself the wind circulates in the direction of the hands of a watch, in front nearly in a circle, in rear more spirally inwards, so that north and north-east winds prevail at C in the second of the above diagrams, where theoretically north-west winds should have been found, as at C in the first. The whole system is moreover an eddy on the side of a great area of high pressure lying to the south and east, which is the source of the south-east trade in the Indian Ocean. This is shown in the diagram by the position of the isobar of 29·9 inches.

These two latter facts—the incurvature of the wind, and the consideration of the whole cyclone as part of a general wind system—are the most important developments which have been made of the early crude theory of cyclones, which treated them as circular eddies without any

reference to their surroundings. This development is largely due to the researches of Mr. Meldrum, and the improved rules which he has laid down for the handling of ships in hurricanes have considerably diminished the number of disabled vessels which run in annually to Mauritius for repairs.

We also wish to call attention particularly to the fact that a typical real cyclone is not round but oval, as shown in the second diagram, the isobars being not concentric, but massed towards one side, usually the rear, as in this case. The longest diameter of the oval does not always lie along the line of the cyclone's progress, especially when the hurricane is recurving. However, in most cases the longest diameter lies as shown, and this elongation of the storm has an important influence on the direction of the wind in reference to the central vortex.

Before attempting to give even a sketch of these improvements we must say something about the manner in which these whirling masses of air move as a whole. Almost every cyclone begins by moving very slowly—often only two or three miles an hour—from the east or east-north-east; some continue in this direction, but most recurve and travel with an increased speed of fifteen to twenty miles an hour towards the south-east.

The whole art of handling ships in hurricanes turns round a knowledge of the position of the centre and the direction in which the whole travels. The crude theory is that, as the wind blows in a circle, you have only to hold out your left arm square to the front facing the wind and your hand points to the centre in the Southern Hemisphere. The motion of the centre is found thus. On the same theory, the wind does not change its direction as you approach the centre on the line of the path of the vortex. In the diagram the wind is south-east

all along the vortex path. But if any other part of the cyclone passes over you the wind will shift, and, as this shift is different on the right and left sides of the hurricane, you can tell which way the cyclone is moving. For instance, anywhere on the left of the path, say from F to E, the wind will shift from east-south-east to east and then to north, while if you encounter the right side of the cyclone from D to C the shift will be from south, by west, to north-west.

The moment a mariner in these latitudes sees the barometer falling with a freshening wind, he begins to expect a hurricane and thinks how to escape. His only guide is this knowledge of the direction in which the centre lies when the wind blows from a certain quarter, and of the motion of the whole cyclone. The critical case is when the ordinary south-east trade freshens with a falling mercury. The captain looks at an ordinary diagram of a cyclone and sees, as in the first of the above diagrams, that a south-east wind blows exactly in front of the centre of a cyclone coming from north-east—the theory takes no heed of the fact that the whirl is not an isolated disturbance, but an elongated eddy in a south-east current—and he runs his ship to the north-west in hope of escaping the dangerous vortex.

But when we look at a real cyclone, as in the second diagram, we find a belt of intensified south-east wind a long way to the south of the centre where the barometer has fallen below the ordinary level of 29·9 inches. This is partly due to the elongation or oval shape of the cyclone, and partly to the whole being superimposed on a general pressure slope for south-east winds.

Take, for instance, the ship marked A in the second diagram. She has a hard gale, force 9, from south-east, with the mercury down to 29·6.

According to theory, the centre should bear north-east

of her, and she should run to the north-west. In practice the centre lies north by east, and if she runs to north-west she will probably sail right into the vortex.

The ship marked B has also got a gale from south-east and barometer also at 29·6. The centre really bears north-east of her and she is lying exactly in front of the vortex, as the ordinary theory says. The position in either case is one of the greatest danger, and how is the unfortunate commander to know whether to run to north-west, as B ought to do, or lie to on the port tack, which would be the safety of A?

Mr. Meldrum's practical rule is that the barometer must fall no less than six-tenths of an inch without a change in the direction of the wind, before you may safely conclude that you are actually in front of an approaching cyclone.

The diagram will explain why. If A remains lying to, the isobar of 29·3, which is six-tenths below the ordinary height of 29·9, will probably never touch her, though her barometer will continue to fall, and, even if it did touch 29·3, the wind by that time would have begun to turn towards east or north-east.

B, on the contrary, when the isobar of 29·3 reaches her, that is when her barometer marks that pressure, will still find the wind from south-east and everything getting rapidly worse. Her commander knows then that he is on the line of vortex path and runs away to north-west.

The incurving wind in rear of a cyclone explains the ease with which ships get drawn into the dreaded vortex if once they begin to run before the wind and then the sea becomes too high for them to lie to. For instance, in the second diagram, a homeward-bound ship at C finds a strong north-east wind with falling barometer and ugly-looking weather. If her commander thinks he is near a hurricane, he looks at the theoretical cyclone, as in the first

diagram, sees that a north-east wind blows to the south-east of the centre, and thinks that a fine fair wind will bear him safely towards the Cape of Good Hope. Unfortunately, in practice the north-east wind is blowing nearly straight into the vortex. He may run twelve knots, while the cyclone may only move at the rate of two miles an hour. He soon runs into the kernel of the hurricane, then cannot lie to, if he wants to do so, and is soon sucked into the vortex. This would undoubtedly happen to our ship at C if she runs instead of lying to till the look of the weather improves and the barometer begins to rise.

One of the greatest dangers of hurricanes in these seas arises from their very slow progress. When a ship once gets involved she may be two or three days before she gets clear, as the cyclone takes that time to pass over her.

A remarkable instance of this once occurred to an East Indiaman called the *Earl of Dalhousie*. Coming home from India, she mistook the strong north-east wind in rear of a hurricane for a favourable wind, before which she ran and was soon engulfed in the most dangerous portion of the cyclone. Three times she ran round the centre in a circle of 90 to 100 miles circumference, completing the circuit in nine or ten hours each time. Once she was sucked into the calm of the central vortex, but then thrown out by the first blasts of north-westerly wind in rear of the hurricane as the cyclone moved on. This was only possible because the whole cyclone scarcely moved more than three miles an hour; but soon the rate increased to ten miles an hour, so that the ship had not time to run round again before the storm began to pass away. She then held her course to the south-west, when the cyclone, recurving towards the south-east, caught her again, and blew her half way round the compass, for the fourth time. The rudder then gave way, she broached to, went on her beam ends, and the masts had to

be cut away to save her. There is hardly a hurricane on record in which ships have not been thus drawn in and pirouetted about the Indian Ocean.

Mr. Meldrum's rule is that homeward-bound ships which meet a strong north or north-east wind anywhere in the hurricane region of the Indian Ocean must lie to till all appearance of bad weather has passed away. We now see both the reason for and value of this important warning.[1]

[1] An abstract of a very complete investigation of the value of Meldrum's rules will be found, *Proc. Royal Society*, vol. xliv. p. 314. Abercromby "On Meldrum's rules for handling ships in the Southern Indian Ocean."

APPENDIX IV

THE RELATION OF TROPICAL TO EXTRA-TROPICAL CYCLONES

A FULL account of my researches are given in a paper under the above title published in the *Proceedings of the Royal Society,* vol. xliii. p. 1. An abstract of the conclusions arrived at was there given as follows:—

CONCLUSIONS.

The conclusions as to the relation of tropical to extra-tropical cyclones which the author has derived from the researches of which this paper gives an account may be stated thus:—

All cyclones have a tendency to assume an oval form; the longer diameter may lie in any direction, but has a decided tendency to range itself nearly in a line with the direction of propagation.

The centre of the cyclone is almost invariably pressed towards one or other end of the longer diameter; but the displacement may vary during the course of the same depression.

Tropical hurricanes are usually of much smaller dimensions than extra-tropical cyclones; but the central depression is much steeper and more pronounced in the former than in the latter.

Tropical cyclones have less tendency to split into two, or to develop secondaries than those in higher latitudes.

A typhoon which has come from the Tropics can combine with a cyclone that has been formed outside the Tropics, and form a single new, and perhaps more intense, depression.

No cyclone is an isolated phenomenon; it is always related to the general distribution of pressure in the latitudes where it is generated. The concentric circles, which are usually drawn to represent a cyclone, ignore the fact that a cyclone is always connected with and controlled by some adjacent area of high pressure.

In all latitudes pressure often rises over a district just before the advent of a cyclone. The nature of this rise is at present obscure; but the character of the unusually fine weather under the high pressure is identical both within and without the Tropics.

In all latitudes a cyclone which has been generated at sea appears to have a reluctance to traverse a land area, and usually breaks up when it crosses a coast line.

After the passage of a cyclone in any part of the world, there is a remarkable tendency for another to follow very soon, almost along the same track.

The velocity of propagation of tropical cyclones is always small, and the average greatly less than that of European depressions.

There is much less difference in the temperature and humidity before and after a tropical cyclone than in higher latitudes. The quality of the heat in front is always distressing in every part of the world.

The wind rotates counter-clockwise round every cyclone in the Northern Hemisphere; and everywhere as an ingoing spiral. The amount of incurvature for the same quadrant may vary during the course of the same cyclone; but in

most tropical hurricanes the incurvature is least in front, and greatest in rear, whereas in England the greatest incurvature is usually found in the right front. Some observers think that, broadly speaking, the incurvature of the wind decreases as we recede from the Equator.

The velocity of the wind always increases as we approach the central calm in a tropical cyclone; whereas in higher latitudes the strongest winds and steepest gradients are often some way from the centre. The portion of a cyclone which is of hurricane violence forms, as it were, a kernel in the centre of a ring of ordinarily bad weather. In this peculiarity tropical cyclones approximate more to the type of a whirlwind tornado; but the author does not think that a cyclone is only a highly-developed whirlwind, as there are no transitional forms of rotating air.

The general circulation of a cyclone, as shown by the motion of the clouds, appears to be the same everywhere.

All over the world unusual coloration of the sky at sunrise and sunset is observed not only before the barometer has begun to fall at any place, but sometimes before the existence of any depression can be traced in the neighbourhood.

Cirrus appears all round the cloud area of a tropical cyclone, instead of only round the front semicircle as in higher latitudes. The allinements of the stripes of cirrus appear to lie more radially from the centre in the Tropics, instead of tangentially to the isobars, as indicated by the researches of Ley and Hildebrandsson in England and Sweden respectively.

The general character of the cloud all round the centre is more uniform in, than out of the Tropics; but still the clouds in rear are always a little harder than those in front.

Everywhere the rain of a cyclone extends farther in front than in rear. Cyclone rain has a specific character,

quite different from that of showers or thunderstorms; and this character is more pronounced in tropical than in extra-tropical cyclones.

Thunder or lightning are rarely observed in the heart of any cyclone, and their absence is a very bad sign of the weather. Thunderstorms are, however, abundantly developed on the outskirts of tropical hurricanes.

Squalls are one of the most characteristic features of a tropical cyclone, where they surround the centre on all sides; whereas in Great Britain squalls are almost exclusively formed along that portion of the line of the trough which is south of the centre, and in the right rear of the depression. As, however, we find that the front of a British cyclone tends to form squalls when the intensity is very great, the inference seems justifiable that this feature of tropical hurricanes is simply due to their exceptional intensity.

A patch of blue sky in the centre of a cyclone, commonly known as the "bull's-eye," is almost universal in the Tropics, and apparently unknown in higher latitudes. This blue patch does not apparently always coincide exactly with the barometric centre. The author's researches show that in middle latitudes the formation of a bull's-eye does not take place when the motion of translation is rapid; but as this blue space is not observed in British cyclones when they are moving slowly, it would appear that a certain intensity of rotation is necessary to develop this phenomenon.

The trough phenomena—such as a squall, a sudden shift of wind and change of cloud character and temperature just as the barometer turns to rise, even far from the centre—which are such a prominent feature in British cyclones, have not been even noticed by many meteorologists in the Tropics. The author, however, shows that there are slight indications of these phenomena everywhere; and he has

collated their existence and intensity with the velocity of propagation of the whole mass of the cyclone.

Every cyclone has a double symmetry. One set of phenomena, such as the oval shape, the general rotation of the wind, the cloud ring, rain area, and central blue space, are more or less related to a central point. Another set, such as temperature, humidity, the general character of the clouds, certain shifts of wind, and a particular line of squalls, are more or less related to the front and rear of the line of the trough of a cyclone.

The author's researches show that the first set are strongly marked in the Tropics, where the circulating energy of the air is great and the velocity of propagation small; while the second set are most prominent in extra-tropical cyclones, where the rotational energy is moderate and the translational velocity great.

The first set of characteristics may conveniently be classed together as the rotational, the second set as the translational phenomena of a cyclone.

Tropical and extra-tropical cyclones are identical in general character, but differ in certain details due to latitude, surrounding pressure, and to the relative intensity of rotation or translation.

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THE END

METEOROLOGICAL WORKS BY THE AUTHOR.

PRINCIPLES OF FORECASTING by means of Weather Charts. 2d Edition, Revised, 123 pages, 65 illustrations. 2s. Issued by the authority of the Meteorological Council.—London, 1883. Edward Stanford.

This book explains the principles on which weather forecasts are framed by the Meteorological Office. The details and illustrations refer to Great Britain only.

WEATHER: A popular exposition of the nature of weather changes from day to day. 2d Edition, 472 pages, 96 illustrations. 5s. —International Scientific Series, No. 59. London, 1887. K. Paul, Trench, and Co. American Edition. New York. Appleton and Co.

This book sketches the great principles of Meteorology as a whole, and gives a clear picture of the conclusions as to the actual nature of weather to which meteorologists have been led. Many books have been written on storms and climate, but none on everyday weather; and to those who have hitherto only known meteorology as a dull branch of statistics, this volume will open up a new prospect in science and a new vision to the mind. The illustrations are taken from all parts of the world.

"The author has the qualities of a born teacher—clear and accurate statements, picturesque and graphic language, and a logical order of arrangements." —*American Meteorological Journal.*

INSTRUCTIONS FOR OBSERVING CLOUDS on Land and Sea. 22 pages. Photo-plate of ten typical cloud forms, and six woodcuts. 1s. 6d. London, 1888. Edward Stanford.

This little book gives clear instructions for naming the leading varieties of clouds; and for determining both the direction of their motion and the direction in which the linear forms of cirrus trend.

The illustrations are taken from all parts of the world, and the instructions are available for any country.